MAC–MSGRAP 1.3.5

Monticello Mill Tailings Site
Operable Unit III

Annual Monitoring Program

September 1997

U.S. Department of Energy

Work Performed Under DOE Contract Number DE-AC13-96GJ87335 for the U. S. Department of Energy

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Monticello Mill Tailings Site

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Operable Unit III

Annual Monitoring Program

September 1997

Prepared for
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Acronyms

DOE	U.S. Department of Energy
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
ft	feet
GJO	Grand Junction Office
HDPE	high-density polyethylene
in.	inches
MMTS	Monticello Mill Tailings Site
NTU	nephelometric turbidity unit
OU	Operable Unit
pCi/L	picocuries per liter
QA	Quality Assurance
QC	Quality Control
RI	Remedial Investigation
State	State of Utah
μm	micron
μg/L	micrograms per liter

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1.0 Introduction

The Monticello Mill Tailings Site (MMTS), located in San Juan County, Utah, comprises several tracts of land, including the Monticello millsite, the former Bureau of Land Management compound, the South Site, and 25 peripheral properties surrounding the millsite (Figure 1–1). The U.S. Department of Energy (DOE) owns the former three tracts and several of the peripheral properties. Either entities or individuals own the remaining peripheral properties.

Remediation of the millsite has been divided into three operable units (OUs). OU I consists of the excavation of mill tailings and other hazardous substances from the millsite and their containment in permanent repository. OU II consists of the remediation of radioactively contaminated soils, by-product materials, and hazardous substances from private and DOE-owned properties peripheral to the millsite. OU III consists of contaminated surface-water and groundwater on the millsite and downgradient peripheral properties and contaminated soil and sediment along Montezuma Creek.

During the period from November 1992 through October 1996, monitoring of the OU III surface-water and groundwater was conducted in accordance with the *Monticello Mill Tailings Site, Operable Unit III, Remedial Investigation Work Plan, Field Sampling Plan, and Quality Assurance Project Plan* (most recent version September 1995) and Program Directives that modified these plans. The results of these monitoring efforts are documented in the *Monticello Mill Tailings Site, Operable Unit III, Remedial Investigation/Feasibility Study—Environmental Assessment* (OU III RI/FS) (in preparation). This Annual Monitoring Plan presents a surface-water and groundwater monitoring program to be implemented during finalization of the OU III RI/FS and during preparation of the OU III Proposed Plan and Record of Decision. This plan revises the monitoring program that was conducted from November 1992 to October 1996; the program was revised because the ecological and human health risk assessments and RI are complete or being completed, which has eliminated the need to collect additional data for these efforts.

The objectives of this annual monitoring program are to provide information on and document changes in surface-water and groundwater quality, groundwater water-levels, and stream flow during the implementation of millsite excavation in 1997 and 1998. The first sampling to occur under this plan will be during October 1997. If the results of any of the sampling events specified in this program indicate that significant changes are occurring in water quality and/or flow and water levels, then revisions to this program will be considered and discussed with the U.S. Environmental Protection Agency (EPA) and the State of Utah (State) prior to implementation.

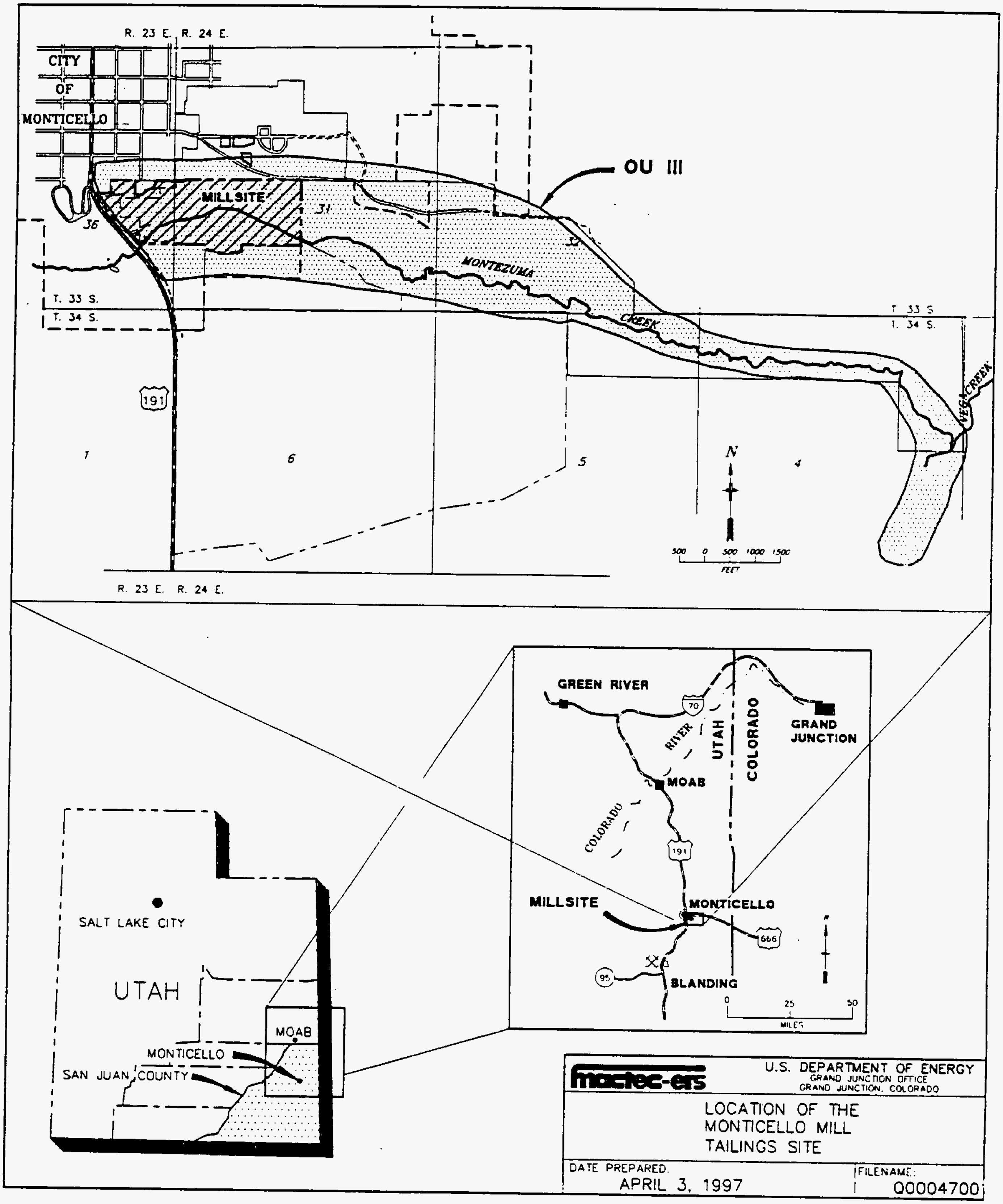

Figure 1–1 Monticello Mill Tailings Site, San Juan County, Utah

2.0 Water Sampling Locations and Frequency

As specified in the *Monticello Mill Tailings Site, Operable Unit III, Remedial Investigation Work Plan, Field Sampling Plan*, and *Quality Assurance Project Plan* (September 1995) and revised with EPA and State agreement in April 1996, the semiannual (April and October) sampling program consisted of sampling 18 groundwater monitoring wells and four surface-water locations in April and 36 monitoring wells and 18 surface-water locations in October. Specific locations are shown in Table 2–1 under the column "Remedial Investigation Sampling Events."

Under this plan, six monitoring wells and four surface-water locations will be sampled in April (beginning in 1998) and 24 monitoring wells and eight surface-water locations will be sampled in October. These groundwater and surface-water samples will be collected on a variable schedule from sampling locations specified in Table 2–1 and shown in Figures 2–1 and 2–2. Sampling events will be conducted in October during 1997 and in April and October in subsequent years or until this plan is modified. The following information was considered in designing the sampling network. During the fall, Montezuma Creek exhibits base flow conditions, water levels in the alluvial system are generally the lowest, and contaminant levels are generally highest in both surface water and groundwater. Therefore, an October sampling event is designed to be the most extensive sampling round. Locations throughout the OU III study area will be monitored in October, including monitoring wells completed in the alluvium and Burro Canyon, Dakota Sandstone, and Mancos Shale Formations and surface water in Montezuma Creek.

During the spring, Montezuma Creek exhibits high-flow conditions, water levels in the alluvial aquifer are generally the highest, and contaminant levels are generally lowest in both surface-water and groundwater. An April sampling event was chosen to coincide with these flow/water level conditions; monitoring during this event will not be as extensive as during the October event because contaminant levels do not peak during this time of year. The April sampling event includes alluvial monitoring wells and surface-water sampling locations downgradient of the millsite; these locations are expected to reflect changes in millsite conditions most quickly.

Collection of groundwater and surface-water samples from upgradient of the site has been reduced because upgradient water quality has been well characterized. The objective of additional sampling in this area is to monitor for major changes in quality of the water entering the site. This objective is best fulfilled by collecting samples from locations immediately upgradient of the site annually in October.

Collection of groundwater samples from the millsite has been reduced because nearly all wells have been abandoned or will be excavated during millsite remediation. The remaining wells are located upgradient of the tailings piles. No major changes are anticipated in the water quality from these wells and therefore annual monitoring in October is sufficient. Seeps on the millsite were eliminated from the monitoring program because they will be excavated during millsite remediation.

Table 2–1. Groundwater and Surface-Water Sampling Locations and Frequency

SAMPLING LOCATION			REMEDIAL INVESTIGATION SAMPLING EVENTS		ANNUAL MONITORING EVENTS	
General Location	Description	Location ID	April	October	April	October
Upgradient	Alluvial	92–01		X		
		92–03		X		
		92–05		X		X
	Burro Canyon	92–02		X		
		92–04		X		
		92–06		X		X
	Dakota Sandstone	92–13		X		X
	Montezuma Creek	SW92–01		X		
		SW92–02		X		
		SW92–03		X		X
		SW95–01		X		
Millsite	Alluvial[b]	82–20				X
		82–30B	X	X		
		82–40A		X		
		82–42		X		
		82–31BE		X		
		31SW91–03		X		
		31SW91–14		X		
		31SW91–23		X		
		36SE91–58	X			
		36SE93–201–2	X	X		
		31SW91–55	X			
		31SW91–50	X			
		31SW93–200–4				X
	Burro Canyon	93–01	X	X		X
		31SW93–200–1				X
	Dakota Sandstone	31SW93–200–2				X
	Mancos Shale	31SW93–200–3				X

[a]Annual monitoring events are those established by this document; April sampling to be initiated in 1998;October sampling to be initiated in 1997.
[b]Other than wells 82–20 and 31SW93–200–4, all millsite alluvial wells have been abandoned or will be excavated during millsite remediation.

Table 2–1. Groundwater and Surface -Water Sampling Locations and Frequency (continued)

SAMPLING LOCATION			REMEDIAL INVESTIGATION SAMPLING EVENTS		ANNUAL MONITORING EVENTS[a]	
General Location	**Description**	**Location ID**	**April**	**October**	**April**	**October**
Millsite	Montezuma Creek	SW92–04		X		X
		SW92–05	X	X		X
		W–2		X		
		Carbonate Seep		X		
		North Drainage		X		
		Slade Spring		X		
Downgradient	Alluvial	82–07		X	X	X
		88–85		X	X	X
		92–07		X		
		92–08		X		
		92–11	X	X	X	X
		92–09	X	X	X	X
		95–01	X	X	X	X
		95–03	X	X	X	X
		P92–02		X		
		P92–04		X		
		P92–09	X	X		
	Burro Canyon/Dakota	83–70		X		X
	Burro Canyon	95–02	X	X		X
		95–04	X	X		X
		95–06	X	X		X
		95–08	X	X		X
		31NE93–205		X		X
		92–10	X	X		X
	Dakota Sandstone	92–12	X	X		X
		95–07	X	X		X

[a]Annual monitoring events are those established by this document; April sampling to be initiated in 1998;October sampling to be initiated in 1997.

Table 2–1. Groundwater and Surface-Water Sampling Locations and Frequency (continued)

SAMPLING LOCATION			REMEDIAL INVESTIGATION SAMPLING EVENTS		ANNUAL MONITORING EVENTS[a]	
General Location	**Description**	**Location ID**	**April**	**October**	**April**	**October**
Downgradient	Montezuma Creek	W–4		X	X	X
		SW92–06		X	X	X
		Sorenson Site	X	X	X	X
		SW92–07	X	X	X	X
		SW92–08		X		X
		SW92–09		X		
		SW94–01	X	X		
		Montezuma Canyon		X		

[a]Annual monitoring events are those established by this document; April sampling to be initiated in 1998;October sampling to be initiated in 1997.

The objective for monitoring downgradient groundwater locations is to provide water quality information to monitor plume movement. The strategy for selection of downgradient sampling locations to meet this objective is to sample all locations where alluvial wells are paired with wells completed in bedrock formations and to sample additional alluvial wells located in between areas with paired wells to achieve a good overall distribution of sampling locations. Because no response in bedrock water quality is expected due to millsite remediation (data to date indicate that bedrock water quality is not contaminated), bedrock wells will only be sampled annually.

Monitoring of surface-water locations downgradient of the millsite was reduced from that during the remedial investigation by eliminating those locations furthest from the site. Previously collected data indicate that downgradient of the Sorenson site contaminant concentrations attenuate in the surface water.

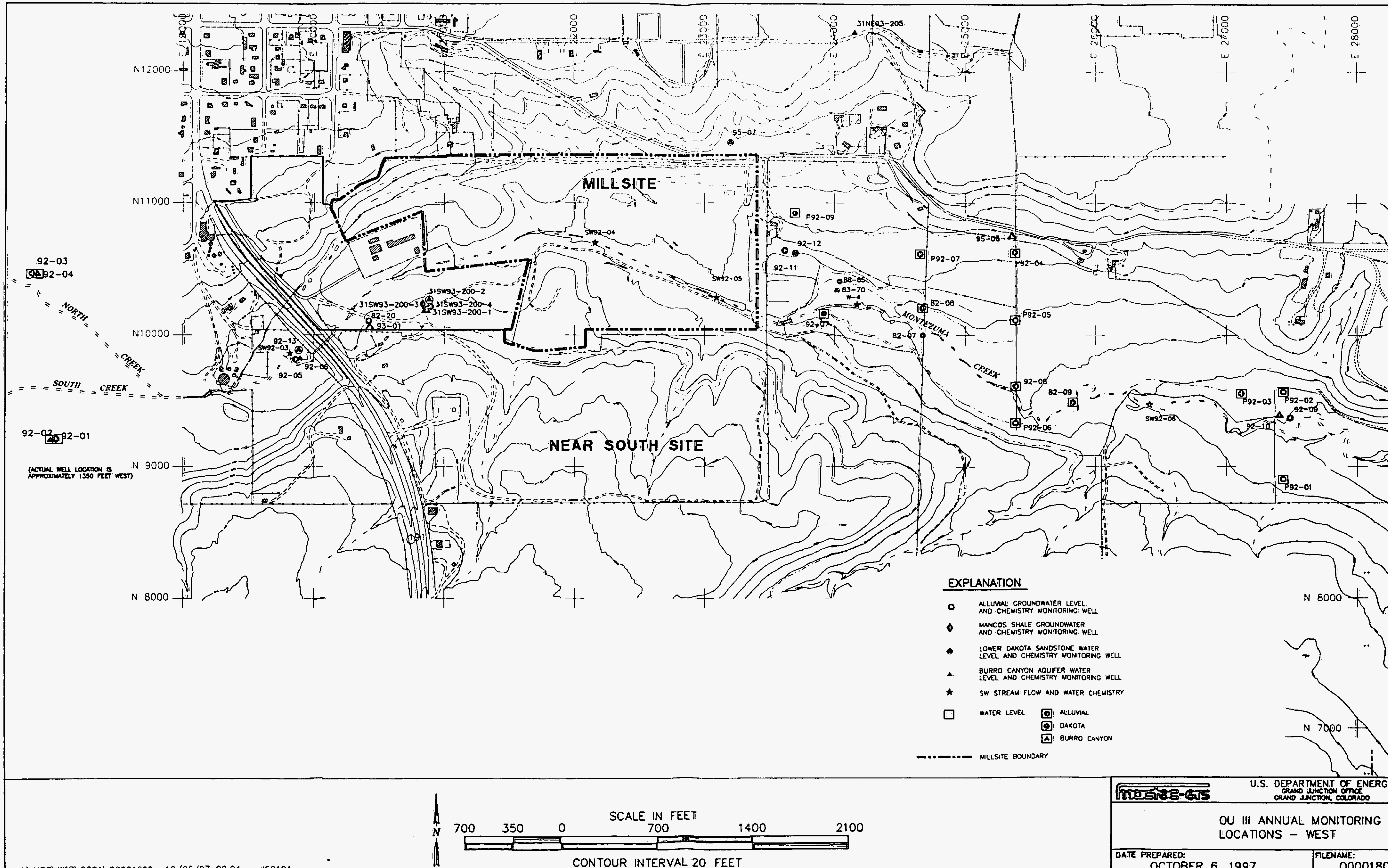

Figure 2-1. Groundwater and Surface Water Monitoring Network—West

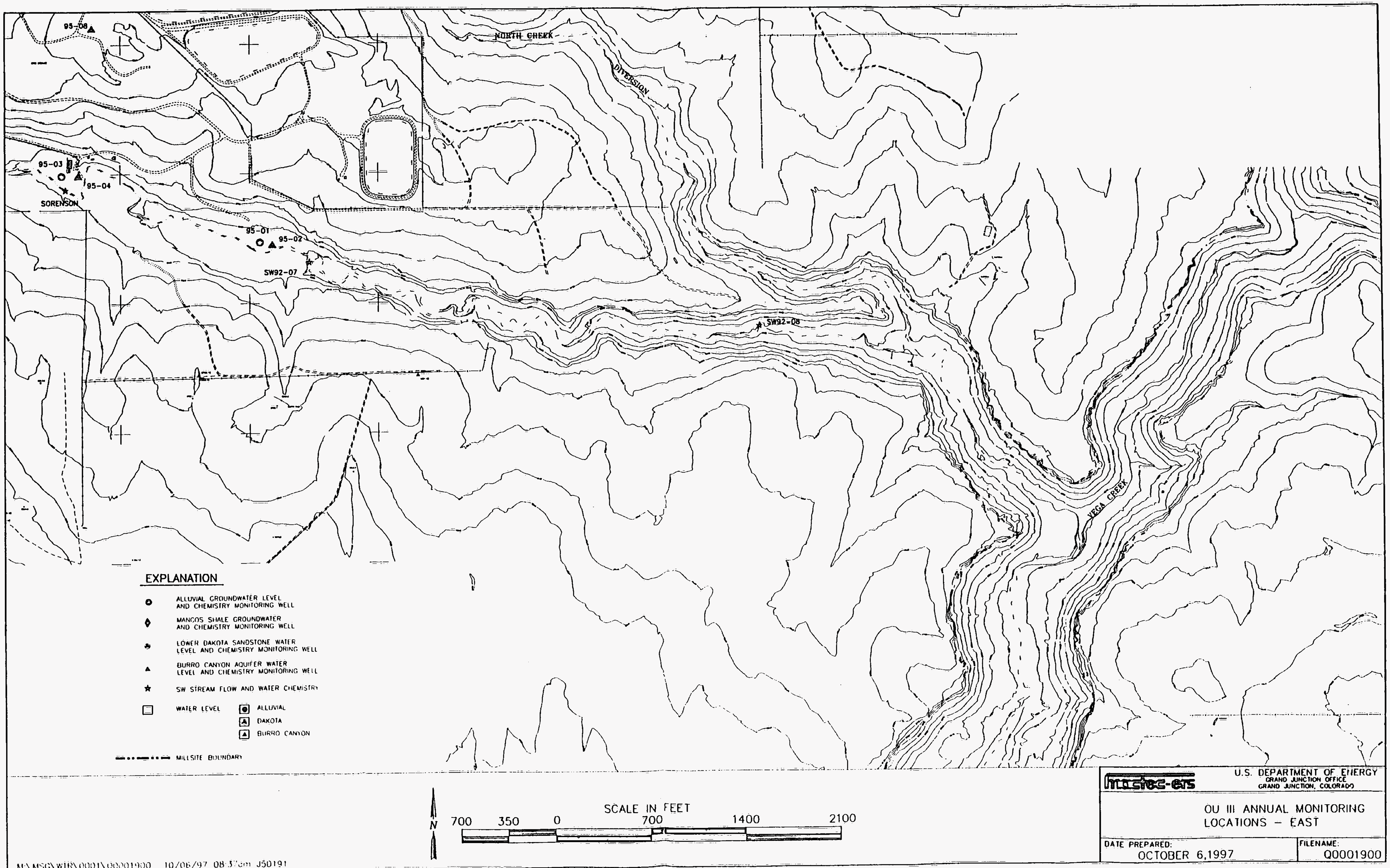

Figure 2–2. Groundwater and Surface Water Monitoring Network—East

3.0 Sampling Procedures

3.1 Work Area Preparation

Delineation of the work area and covering the work area with water-impermeable sheeting is required at specific sampling locations. At locations upgradient of the millsite, the work area will be delineated with tape, but ground covering is not required; at millsite sampling locations, delineation of the sampling area and covering the ground with plastic is not required; and, at downgradient sampling locations accessible by passenger vehicle, the sampling area will be delineated with tape, and the ground surface will be covered with plastic. Where passenger vehicle access is not possible, delineation of the sampling area is not required and the ground surface will be covered with plastic. Vehicles will be turned off prior to sample collection.

3.2 Well Purging

3.2.1 Well Purge Criteria

Prior to collecting a groundwater sample from a monitoring well, the well will be purged according to the procedural and equipment requirements prescribed in this section. The goal of purging is to remove potentially unrepresentative water from the well casing and filter pack while allowing new formation water to recharge the well in the sampling interval.

The depth to groundwater will be initially measured with an electric sounder before purging the well (GJO Procedure LQ-2[T] of the GJO Environmental Procedures Catalog [GJO 6]; Appendix A). Well depth, casing diameter, radius of well bore, and depth to water will be used to calculate the volume of water in the borehole. Well completion logs will be available in the field to provide the correct dimensions for volume calculations.

The volume of water to be purged from wells has been revised from the criteria in the "Standard Practice for Purging of Monitoring Wells" (GJO Procedure LQ-3[P], Appendix A). Prior to sample collection, a minimum of one borehole volume will be evacuated and measured field parameters will have stabilized. A minimum of one reading of each field measurement will be recorded approximately every one-sixth borehole volume calculated. The borehole volume is determined according to the following equations:

Casing Volume (gallons) = $(r/12)^2 \times \pi \times (h_1 - h_2) \times 7.48$, where

r = radius of well casing (inch [in.]),

π = 3.14,

h_1 = depth of well (feet [ft]) from top of well casing,

h_2 = depth to water (ft) from top of well casing,

7.48 = gallons per cubic ft.

Filter Pack Volume (gallons)	=	$[r/12)^2 - (r_1/12)^2] \times \pi \times (h_3 - h_4) \times 7.48 \times 0.30$, where
r	=	radius of well casing (in.),
π	=	3.14,
h_1	=	depth of well (ft) from top of well casing,
h_2	=	depth to water (ft) from top of well casing,
r_2	=	radius of well bore (in.),
h_3	=	depth to top of filter pack (ft) from top of well casing,
h_4	=	gallons per cubic ft.,
7.48	=	gallons per cubic ft, and
0.30	=	estimated porosity of filter pack (30 percent).

Borehole Volume = Casing Volume + Filter Pack Volume

3.2.2 Field Parameter Monitoring

The parameters temperature, conductivity, pH, and turbidity will be monitored throughout the well purging process. For wells that are pumped, probes to monitor temperature, conductivity, and pH will be immersed in a flow-through cell during purging. If a pump is not used for purging the well, measurement of temperature, conductivity, and pH will be made in an open container. Turbidity will be measured with a portable turbidity meter which requires a sample to be obtained from the pump/flow cell discharge or from the bailer.

The calibration and quality control (QC) procedures for field measurements obtained for groundwater stabilization criteria are presented in Table 3.2.2–1. The criteria defining field parameter stability have been revised from Procedure LQ-3[P] as follows: stability is indicated when turbidity is ≤5 nephelometric turbidity units (NTUs), pH is within ± 0.3 pH units, and conductivity and temperature are each within ± 10 percent of the most current three consecutive readings. A minimum of one reading will be recorded for approximately every one-sixth borehole volume evacuated. Sample collection may commence after one borehole volume is purged and stability criteria are met. As stated previously, if a well is purged dry, all stagnant water is assumed to have been removed from the well, and sampling can occur when sufficient recovery has occurred (sample collection from slow recovering wells is discussed below). Alkalinity will be measured in the field after well purging criteria have been met.

If the 5 NTU criteria cannot be attained and proper well construction and development have been demonstrated, sampling will commence and the results will be evaluated with consideration of sample turbidity.

Procedures for the field measurement of pH, conductivity, alkalinity, temperature, and turbidity are presented in Appendix A (GJO Procedures LQ-4[T], LQ-5[T], LQ-7[T], LQ-8[T], and LQ-24[T], respectively). The standard solutions used for calibration and operational checks on the field instrumentation will be brought to within 10 degrees centigrade (°C) of the temperature of the purged water. The pH meter will be calibrated before taking measurements at each well, and the conductivity and turbidity measuring devices will be operationally checked before taking measurements at each well. Any deviations from these measurements or instrument failures that can not be corrected prior to sample collection will be documented as a field variance in the field logbook (reference Section 4.5.6, Nonconformance and Corrective Action Procedure).

Table 3.2.2–1. Calibration and QC Procedures for Field Parameter Measurements

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Actions	Data Flagging Criteria
LQ-4(T)	pH (water)	2 point calibration with pH buffers	At each sample location before obtaining the sample	±0.3 pH units	If calibration is not achieved check meter, probe, and buffer solutions. Repeat calibration. If still out, flag data.	Record as a Field Variance in the field logbook
LQ-5(T)	Conductance	Calibrate with KCL standard	At each sample location before obtaining the sample	±10% most current three consecutive readings	If calibration is not achieved check meter, probe, and standard. Repeat calibration. If still out, flag data.	Record as a Field Variance in the field logbook
LQ-8(T)	Temperature	None	At each sample location before obtaining the sample	±10% most current three consecutive readings	Check meter and probe. Repeat measurement. If still out, flag data.	Record as a Field Variance in the field logbook
LQ-24(T)	Turbidity	Operationally check to NTU standards	At each sample location before obtaining the sample	≤ 5NTUs most current three consecutive reading	Check meter, batteries, and standards. Wipe NTU standard container clean. Repeat measurements. If still out, repeat primary calibration.	Record as a Field Variance in the field logbook

3.2.3 Purging Methods and Equipment

Well purging will be accomplished using a peristaltic pump, bladder pump, bailer, or submersible pump using Methods A, B, C, or D in the "Standard Practice for Purging of Monitoring Wells" (GJO Procedure LQ-3[P], Appendix A). Dedicated bladder pumps are present and will be used for purging in 9 of the 24 wells in the sampling network as listed in Table 3.2.3–1. The method of purging the remaining wells will be determined in the field on the basis of well-specific conditions (e.g. depth to water, expected recovery rate of the well). For example, wells 83–70 and 31NE93–205 have been purged previously with a submersible pump due to large purge volume or relatively deep water level. Typically, wells 92–12 and 92–13 have each been purged by means of a bailer due to very slow recovery rates. Purging (and sampling) equipment is documented on the water sampling field data form for each well (Appendix A, Procedure LQ-3[P]). If a well is purged dry, all potentially unrepresentative water is assumed to have been removed, and sampling can proceed when sufficient recovery has occurred.

Table 3.2.3–1. Wells With Bladder Pumps

Well Numbers		
82–07	83–70	88–85
92–05	92–06	92–09
92–10	92–11	93–01

3.3 Sample Collection Methods

3.3.1 Groundwater

Sample fractions not requiring field filtration (samples collected for radon-222 analysis) will be collected directly from the pump discharge line (not the flow-through cell discharge) or directly from the bailer, depending on the purge method. Bailed samples requiring field filtration will first be poured into an unused dummy sample bottle from which the sample will then be pumped by a peristaltic pump through an in-line filter to the sample bottle. Pumped samples will be filtered by directly affixing the filter to the discharge line outlet. Samples will be filtered through 0.45-micron (μm) in-line disposable cartridge-type filters.

Standard collection procedures are described in "Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples" (GJO Procedure LQ-12[P], Appendix A). Radon-222 samples will be collected with a bladder pump, bailer, or a submersible pump, as described in Methods B, C, or D, respectively of GJO Procedure LQ-12[P]. The remaining groundwater sample fractions may be collected by either peristaltic pump, bladder pump, bailer, or submersible pump, using Methods A, B, C, or D, respectively of GJO Procedure LQ-12[P]. The order in which the various parameters are collected will proceed from most sensitive to least sensitive.

Water samples collected for radon-222 analysis will be collected with no headspace or bubbles in the container. All other water sample containers will be filled to approximately 90 percent capacity to allow for expansion of the contents. If the container overflows when being filled with the collected sample, the exterior of the container will be rinsed with distilled water and wiped dry before being packed for shipment.

Whenever full well recovery exceeds 2 hours, samples will be collected as soon as sufficient volume is available for a sample for each parameter. Care will be taken to pump wells slowly that have a low recharge rate. The slow pumping will minimize formation water cascading down the sides of the screen potentially resulting in accelerated loss of radon.

3.3.2 Surface Water

Surface-water sampling locations will be approached from downstream to minimize the potential for introducing sediments into the sample from walking in the creek. Surface-water field measurements of pH, temperature, and conductivity will be taken in-situ; alkalinity will also be measured in the field. Surface-water samples will be collected from the middle of the stream. All surface-water samples except those requiring filtration, will be collected by container immersion by pointing the bottle mouth upstream (GJO Procedure LQ-11[P], Appendix A, Method G). Filtered samples will be collected with a peristaltic pump (Method A) with the pump intake submerged in the stream. Samples will be filtered through 0.45-μm in-line disposable cartridge-type filters. Both unfiltered and filtered surface-water samples will be collected for metals analyses.

3.4 Water Sampling Equipment

Table 3.4–1 lists equipment and supplies for groundwater sampling.

Table 3.4–1. Water Sampling Equipment

Turbidity Meter and Standards	Deionized Water
HACH Alkalinity Kit	Organic Free Water
Flow Cells	Alconox
YSI Water Quality Monitor (temperature, conductivity, Eh, and pH)	Baking Soda
Electric Water-Level Indicator	Absorbent Tissues
Masterflex Peristaltic Sampling Pump (or equivalent)	Custody Seals or Evidence Tape
Grundfos Redi-Flo2 Model Submersible Pump (with control box and tubing)	Ice Chest with Blue Ice/Wet Ice (or equivalent)
Purge Water Containers	Field logbook
Portable Generator	Chain of Sample Custody Forms (form GJO 1512)
Compressor	Shipping Papers for Acid Preservatives
QED Dedicated Bladder Pumps, Models T-1200 and T-1500	Material Safety Data Sheets (MSDSs)
QED Bladder Pump Control Box	Water Sampling Field Data Sheets
Teflon Bailers	Ticket Book and Sample Labels (with bar codes)
Bailer Reel	Well Completion Information
Disposable Bailers	Calculator
0.45-µm Pore-Size Disposable Filters	Latex Gloves, Safety Glasses, Steel-Toed Boots, and Hard Hats
Sample Bottles	Squirt Bottles
Conductivity Solution	Toolbox
Zobel Solution	Card Table
Concentrated HCL, H_2SO_4, and HNO_3	Gasoline
pH Buffers (4, 7, and 10)	Well Keys
100, 1,000, 10,000 µmho/cm Conductivity Solutions	Waste Containers
pH Paper	Field Sampling Plan
Pipette with Tips	Two-Way Radio
Silicone Tubing	Plastic Sheeting
Buckets	Flagging Tape
	Clear Tape

3.5 Quality Control Samples

QC samples that will be collected in conjunction with OU III water sampling include field duplicates and field equipment blanks. Refer to Table 3.5–1 Quality Control Sample Collection Repeat Measurement Frequencies.

Table 3.5–1. Quality Control Sample Collection and Repeat Measurement Frequencies

Matrix	Sample Type	Frequency	Analysis
Groundwater	Field Duplicate	1 per 20 or fewer locations	Same as environmental sample
Surface water	Field Duplicate	1 per 20 or fewer locations	Same as environmental sample
Groundwater	Equipment Blank	1 per 20 or fewer locations	Same as environmental sample
Surface water	Equipment Blank	1 per 20 or fewer locations	Same as environmental sample
Groundwater–Water level measurement	Repeat measurement	1 per 10 or fewer locations	Not Applicable
Surface-water–Stream discharge measurement	Repeat measurement	1 per 10 or fewer locations	Not Applicable

3.5.1 Field Duplicates

Duplicate surface-water and groundwater samples will be collected in the field on a frequency of one duplicate sample per 20 water samples (or less) for each media and analytical parameter. Surface-water and groundwater are considered separate media in the context of field duplicates. Duplicate water samples will be collected by alternately filling the original and duplicate sample container per analytical parameter. Duplicate samples will be submitted blind to the laboratory under a fictitious identity that is similar to the actual sampling locations.

3.5.2 Equipment Blanks

Equipment blanks provide a check for cross-contamination of samples by ineffective equipment decontamination. At a minimum, one equipment blank sample will be prepared in the field for every 20 water samples (or less) that are collected with non-dedicated equipment. Additional equipment blanks will be collected when circumstances warrant (i.e., change in decon source water or assigned personnel). Equipment blanks will be prepared by collecting a sample of the final deionized rinse water (rinsate) used to decontaminate non-dedicated sampling equipment. Equipment blank samples will be submitted blind to the laboratory under a fictitious identity that is similar to the actual sampling locations.

3.6 Groundwater-Level Monitoring

Groundwater levels will be measured in a total of 40 upgradient, millsite, and downgradient monitoring wells. Table 3.6–1 summarizes the groundwater-level monitoring network according to the formation in which the well is completed. The locations of the groundwater-level monitoring wells are shown in Figures 2–1 and 2–2.

As indicated in Table 3.6–1, the monitoring well network consists of 24 wells completed in the alluvial system, 10 wells completed in the Burro Canyon Formation, 1 well completed in the

Table 3.6–1. Groundwater Level Measurement Network

General Location	Description	Well Number
Upgradient	Alluvial	92-01, 92-03, 92-05
	Burro Canyon	92-02, 92-04, 92-06
	Dakota Sandstone	92-13
Millsite	Alluvial	82-20, 31SW93-200-4
	Burro Canyon	93-01, 31SW93-200-1
	Dakota Sandstone	31SW93-200-2
	Mancos Shale	31SW93-200-3
Downgradient	Alluvial	82-07, 82-08, 82-09, 88-85, 95-01, 95-03, 92-07, 92-08, 92-09, 92-11, P92-01, P92-02, P92-03, P92-04, P92-05, P92-06, P92-07, P92-09, 31NE93-205
	Burro Canyon	95-02, 95-04, 95-06, 95-08, 92-10
	Burro Canyon/Dakota Sandstone	83-70
	Dakota Sandstone	92-12, 95-07

Burro Canyon/Dakota Sandstone, 4 wells completed in the Dakota Sandstone, and 1 well completed in the Mancos Shale.

Groundwater levels in the monitoring wells will be measured in October 1997 and then in April and October every year to coincide with water quality monitoring and surface-water discharge measurement, which is described in the following section. The water-level measurement network will be periodically reviewed and updated. This may include adding or subtracting wells from the network and/or changing the measurement frequency.

Repeat measurements for depth to water will be taken to verify method repeatability. Water level measurements will be repeated once for every 20 (or less) measurements.

Measurement of depth-to-water in monitoring wells will be made to the nearest 0.01-ft with an electric sounder as describe in Method A in the "Standard Test Method for the Measurement of Water levels in Ground-Water Monitoring Wells" (GJO Procedure LQ-2[T], Appendix A). The document revision accompanying the procedure specifies the reference point on the well from which the depth measurements will be made.

The measured depth-to-water in the wells will be recorded in a hand-held electronic data entry device. Under certain field conditions, water level information may be recorded initially into the bound field logbook and transferred to the electronic data base at the earliest opportunity.

3.7 Monitoring Well Inspection

Inspection of all existing monitoring wells in the study area will occur in conjunction with the scheduled sampling according to the procedures described in the "Standard Practice for the Inspection and Maintenance of Ground-Water Monitoring Wells" (GJO Procedure LQ-18[P], Appendix A). Well inspection information will be recorded in a hand-held electronic data entry device (Procedure LQ-2[T], with document revision) and in the logbook as appropriate.

3.8 Surface-Water Discharge Monitoring

3.8.1 Discharge Monitoring Locations

Surface-water discharge will be quantitatively measured at 8 existing sites along Montezuma Creek. Discharge measurements will be taken at SW92–03 (on Montezuma Creek) located upstream of the millsite. Discharge measurement sites located on the millsite are: SW92–04, and SW92–05. Discharge sites W–4, SW92–06, Sorenson, SW92–07, and SW92–08 are located downstream of the millsite. The locations of the surface-water discharge monitoring sites are shown on Figure 2–1 and 2–2.

3.8.2 Discharge Monitoring Frequency

Surface-water discharge measurements will be taken in October 1997 then in April and October concurrent with water quality sampling and water level measurement activities.

3.8.3 Repeat Measurements

Repeat measurements for surface-water discharge will be taken to verify method repeatability. Surface-water discharge measurements will be repeated for every ten locations.

3.8.4 Method of Discharge Measurement

Stream discharge at the 8 measurement sites along Montezuma Creek will be determined according to the velocity-area method (ASTM Method D 3858-79, "Standard Practice for Open-Channel Flow Measurement of Water by Velocity-Area Method"; Appendix A).

The velocity-area method consists of measuring the representative current velocity in each of multiple partial cross-sections of stream flow. Total discharge at a given location is the sum of the area-velocity products of the individual sections.

The appropriate number of partial sections for velocity measurement is an arbitrary determination due to natural variability in channel shape, size, roughness, and velocity distribution. As a general guideline therefore, a frequency of one velocity measurement per 0.5-ft of stream width will be adopted, with the initial measurement taken 0.25-ft from the reference stream bank. At a minimum, the stream depth will be measured at the midpoint and two endpoints of each partial section, including the depth immediately adjacent to each bank. Stream width and depth measurements will be recorded to the nearest 0.025-ft.

Within each partial cross-section, the velocity will be measured at six-tenths the total depth relative to the upper surface, approximating the average velocity in typical stream depth-velocity profiles (ASTM Method D 3858-79). Within a 1-ft depth stream section, the velocity will therefore be measured at 0.6 ft below the water surface or 0.4-ft above the stream bed.

Stream velocity will be measured with a Swoffer Model 2100 Series Current Velocity Meter (rotating element type), or equivalent. Features of the Swoffer meter include the true depth and six-tenths index scales for rapid depth placement of the rotating element. Velocities will be determined from a 90-second velocity averaging period. Calibration and operation of the current meter will proceed according to the manufacturer's recommendations and the general guidelines described in ASTM Method D 4409-84, "Standard Practices for Velocity Measurements with Rotary Element Current Meters." Instrument calibration results will be documented in the field logbook.

Additional information to be recorded by field personnel includes recent and current weather conditions, crop irrigation (location, point of withdrawal, number of sprinkler heads, etc.), presence or absence of water in tributary streams, bank seepage, and other surface-water withdrawals or returns.

The accuracy of stream-discharge measurements by the velocity-area method is a function of meter accuracy, area and depth measurement accuracy, and representativeness of the measured velocity. To minimize the effects of natural variation on measurement accuracy, the following factors will be considered prior to measurement:

- Straight stream reaches are preferred.
- Uniform flow within a single, well-defined, smooth channel is preferred with no overbank or underbank flow.
- Avoid overhanging brush and submerged vegetation.
- Avoid irregular, rough stream bottoms.
- Avoid eddied, turbulent, and stagnant water.
- Observe rotating elements during velocity measurement to confirm proper operation.

Table 3.8.4–1 itemizes the equipment needs for measuring stream discharge.

Table 3.8.4–1. Surface-Water Discharge Measurement Equipment

Swoffer Current Meter (or equivalent) with operations manual and spare parts Steel Tape (25 ft) or equivalent Deionized Water Alconox Absorbent Tissue Field Logbook	Latex Gloves, Safety Glasses, Steel-Toed Boots, and Hard Hats Squirt Bottles Waste Containers Field Sampling Plan Two-Way Radio

3.9 Equipment Decontamination Procedures

Non-dedicated water sampling equipment will be decontaminated prior to the collection of each sample. Decontamination will proceed according to Method B of the "Standard Practice for Equipment Decontamination" (GJO Procedure GN-13(P), Appendix A).

Decontamination water from millsite and downgradient groundwater sampling sites will be collected and disposed with purge water, as described in the following section. Decontaminated equipment will be wiped dry with clean absorbent tissue and placed in clean protective containers or plastic bags until further use.

3.10 Investigation Derived Waste

All excess water generated during groundwater sampling activities (purge water and decontamination water) at millsite and downgradient wells will be collected at the sampling site. The water will subsequently be transferred and discharged into the wastewater treatment system at the millsite.

Trash generated during all sampling/measurement tasks will be disposed in trash receptacles located within the millsite staging area.

4.0 Sample Management and Sample Analysis

4.1 Sample Containers, Preservation, and Holding Times

Table 4.1–1 summarizes the containers, preservation, holding times, and analytical parameters, for water samples collected in support of the OU III project.

Table 4.1–1. Sample Containers, Preservation, Holding Times, and Analytical Parameters for OU III Water Samples

Analytical Parameter	Container Type/Size[a]	Preservation	Holding Time
Metals (As, Co, Cu, Mn, Mo, Pb, Se, U, V, Zn)	HDPE[b]/500mL Amber	Filter by 0.45-μm filter; HNO_3 to pH<2	6 Months
Major Cations (Ca, Mg, K, and Na) (same bottles as metals)	HDPE		
Major Anions (Cl, F, and SO_4)	HDPE/125 mL	Filter by 0.45-μm filter; Cool to 4 °C	28 Days
Nitrate (NO_3 + NO_2 as N)	HDPE/125 mL	Filter by 0.45-μm filter; Cool to 4 °C; H_2SO_4 to pH<2	28 Days
Total Dissolved Solids (filterable residue)	HDPE/125 mL	Cool to 4 °C	7 Days
Gross Alpha/Gross Beta	HDPE/1 L	Filter by 0.45-μm filter; HNO_3 to pH<2	6 Months
Lead-210	HDPE/1 L	Filter by 0.45-μm filter; HNO_3 to pH<2	6 Months
Radium-226	HDPE/3 @ 1 L	Filter by 0.45-μm filter; HNO_3 to pH<2	6 Months
Radon-222	Amber Glass w/Teflon Septa/ 3 @ 40 mL	Cool to 4 °C	Not Estab.
Th-230 (from same bottle as U-234/235/238)	HDPE		
U-234, U-235, and U-238	HDPE/1 L	Filter by 0.45-μm filter; HNO_3 to pH<2	6 Months

[a]Sample volumes may vary according to laboratory requirements.
[b]HDPE = high-density polyethylene

All bottles used will be new and pre-cleaned according to EPA protocol in *Specifications and Guidance for Contaminant-Free Sample Containers* (EPA 1992a). Suppliers will provide certificates of analysis as verification of bottle cleanliness. Bottles will be visually inspected for integrity and cleanliness before use. Suspect containers will not be used and will be discarded.

Sample fractions that require cooling will be placed in an cooler after collection and maintained at temperatures between 0 °C and 4 °C until laboratory analysis. The cooler will be checked for the presence of ice and replenished if necessary, following final collection and storing of samples at each site, and prior to shipment. The cooler temperature will be recorded in the field logbook. Cooler temperatures will be measured at the laboratory upon receipt.

Preservation of some water sample fractions requires addition of specific acids to achieve a desired pH. Following the acidification of the appropriate samples, the required pH will be confirmed on a frequency of one pH measurement per acid type, per bottle size, per sample. A small amount of sample will be poured from a sample container onto pH indicator paper to prevent contamination of the sample. Acid preservation (or other required chemical preservative) will occur as soon as possible after sample collection. Preservative may be added to bottles prior to sample collection if practical.

If chemical preservation cannot be accomplished at the sampling site, samples will be maintained at temperatures between 0°C and 4°C until preservation can occur. Unless prior approval is obtained, preservation will occur on the same day as sample collection and prior to sample shipment.

4.2 Analytical Program

Chemical analysis of water samples will be performed by the Grand Junction Office (GJO) Analytical Chemistry Laboratory. The analytical method and method detection limit for each analyte are shown in Table 4.2–1. Because high total dissolved solids negatively influences the detection of gross alpha and gross beta, a coprecipitation method in addition to GJO's Analytical Chemistry Laboratory standard evaporation method will be used for analysis of all surface-water samples and bedrock groundwater (Mancos, Dakotas or Burro Canyon) samples collected. The coprecipitation method involves use of barium sulfate, and iron hydroxide to precipitate alpha emitting (and probably beta emitting) radionuclides fiom the sample's dissolved solids. Alluvial aquifer samples need not be submitted for analysis by coprecipitation because gross alpha and gross beta are significantly elevated in the alluvial system (i.e., there is no detection limit problem).

4.3 Sample Handling, Packaging, and Shipping

Unused sampling equipment, sample containers, and coolers that have been shipped or transported to the site or a sampling location will be kept in clean, secure location to minimize damage, tampering, and possible contamination.

Sample containers will be securely packaged to protect the contents from damage, spilling, leaking, or breaking during transport between sampling and laboratory destinations. Samples in glass containers will be placed in plastic bags and wrapped in bubblewrap or otherwise appropriately contained (slotted foam) to protect the sample container during shipment. Void space in shipping containers may be filled with an inert material or additional ice, if appropriate, to further protect and secure the contents.

Table 4.2–1. Laboratory Reporting Limits and Analytical Methods for OU III Water Samples

Analytical Parameter	Method Detection Limit[a]	Analytical Method[b]
Metals	**(µg/L)**	
Arsenic	6.0	CLP Method 200.7 (Axial ICP-AES)
Cobalt	2.0	EPA SW-846 6020 (ICP-MS)
Copper	2.0	EPA SW-846 6020 (ICP-MS)
Lead	1.0	EPA SW-846 6020 (ICP-MS)
Manganese	5.0	CLP Method 200.7 (Radial ICP-AES)
Molybdenum	1.0	EPA SW-846 6020 (ICP-MS)
Selenium	5.0	CLP Method 200.7 (Axial ICP-AES)
Uranium	2.5	EPA SW-846 6020 (ICP-MS)
Vanadium	1.0	CLP Method 200.7 (Radial ICP-AES)
Zinc	15.0	CLP Method 200.7 (Radial ICP-AES)
Total Dissolved Solids	10,000	EPA Method 160.1
Major Anions		
Chloride	5	EPA Method 300
Sulfate	50	
Fluoride	5	
Nitrate (NO_3 + NO_2 as N)	5	
Major Cations		
Calcium	10	CLP Method 200.7 (Radial ICP-AES)
Magnesium	20	
Potassium	100	
Sodium	50	
Radionuclides	**(pCi/L)**	
Lead-210	2.0	GJO Method RC-6
Radium-226	1.0	GJO Method RC-5
Radon-222	20.0	GJO Method RC-17
Thorium-230	1.0	GJO Method RC-19
U-234, U-235, and U-238	1.0[c]	GJO Method RC-1
Gross Alpha Activity	1.0; TBD[d]	GJO Method RC-3 and Method 00–02–01[e]
Gross Beta Activity	1.0; TBD	GJO Method RC-3 and Method 00–02–01

[a]µg/L = micrograms per liter; pCi/L = picocurie per liter.
[b]GJO laboratory methods listed in the absence of existing Environmental Protection Agency (EPA) methods.
[c]Isotopic uranium analyses will be conducted on water samples collected from bedrock and 95-series alluvial wells only.
[d]TBD = To be determined.
[e]Method 00–02–01 (EPA 1984) is a method for determining gross alpha in drinking water using coprecipitation; although the method specifically addresses gross alpha, beta emitting isotopes will also probably precipitate.

All samples will be handled, packaged, and shipped as environmental samples. Based on the results of prior sampling and analysis, surface-water and groundwater samples collected from the study area do not qualify as "Radioactive Material," and therefore do not need to be handled, packaged, labeled, and shipped as Radioactive Material according to *MACTEC–ERS General Administrative Procedure Manual*, Section 9.0, "Transportation of Radioactive Hazardous Materials" (MAC–1000, 1996).

On arrival to the laboratory, the sample coordinator (recipient) must examine the shipping containers and document the receiving condition, including integrity of custody seals, when applicable. When opening the shipping container the sample coordinator will examine the contents and record the condition of the individual sample containers (e.g., bottles broken or leaking), the temperature of the water bath (when applicable), temperature or condition of frozen samples (when applicable), method of shipment, courier name(s), and other information relevant to sample receipt and log-in. The individual receiving the samples verifies that the information on the sample container(s) matches the information on the Chain of Sample Custody form prior to signing the Custody form.

4.4 Sample Custody

To ensure the integrity of the sample, the Field Supervisor or their designee, is responsible for the care, packaging, and custody of the samples until they are dispatched to the laboratory. The procedures described in "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples," GN-9(P) (Appendix A) will be implemented to provide security and document sample custody.

Custody seals and/or evidence tape will be placed on each ice chest or storage/shipping container that is not in direct control of a sampling team member to maintain physical security of the samples from time of collection to analysis. Samples not in direct control of a sampling team member will be stored in a secured (locked) location. Ice chests, cartons, and trays used for temporary sample storage that are not custody sealed must be in direct control of a field team member.

If samples are transported by subcontract employees or commercial carrier, the shipping container will have custody seals and/or evidence tape placed over the container opening before shipment to ensure that the integrity of the samples is not compromised during transportation. Custody seals are not required for containers or samples that are transported by contractor personnel directly to the GJO Analytical Chemistry Laboratory for analysis. Mailed sample packages should be registered with return receipt requested. If packages are sent by common carrier, receipts are retained as part of the chain-of-custody documentation. Other commercial carrier documents shall be maintained with the chain-of-custody records.

Chain-of-custody records will be used to list all transfers in the possession of the samples and to show that the samples were in constant custody between collection and analysis. Samples that are sent or transported to an analytical laboratory by individuals other than a member of the field sampling team will be accompanied by a Chain of Sample Custody form (GJO 1512), with a copy retained by the originator. When samples are transported to the GJO Analytical Chemistry Laboratory by a member of the field sampling team, the Chain of Sample Custody form may be completed at the sample receiving facility when the transfer is made.

4.5 Documentation and Document Control

All entries in field logbooks, data sheets, and sample labels and on forms will be made with indelible (waterproof) ink and will be legible, reproducible, accurate, complete, and traceable to the sample measurements and/or site location. These documents will be retained as project records. These documents are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the field sampling activities. Field logbooks and forms (sample ticket books, sample collection data sheets, field measurements data forms, sample container certificates of cleanliness, custody forms, shipping forms, etc.) will be stored in a manner that protects them from loss or damage. The Field Supervisors will be the custodians of all records for the duration of field activities. At the conclusion of a field task or sampling event, the field and data collection activities will be reviewed and summarized in a report to the Project Coordinator.

When practical, correction of errors should be made by the individual who made the entry. Errors will be corrected by drawing a line through the error, entering the correct information, then initialing and dating the entry. The erroneous material must not be obliterated.

When a document requires replacement because of illegibility or inaccuracies, the document will be voided and a replacement document will be prepared. A notation will be made on the voided document that a replacement document was completed. The voided document will be retained with the field documentation. The following sections describe the various documents that will be controlled and procedures for field variance reporting.

4.5.1 Field Logbook

Field personnel will use bound logbooks with consecutively numbered pages as field logbooks for each major task performed. The field logbooks will be used to record the daily activities of the field team, record sketch maps of sampling sites, etc., and sample locations, times, and identifications. Observations of conditions that may impact data quality or interpretation will also be noted. Each page will be signed and dated by the person making the entries on that page and by the Field Supervisor after review. An initial's log will be established at the beginning of the logbook to identify personnel authorized to record and/or review and authenticate field data. Any visitors to the site (DOE, EPA, State) will be noted, as well as their arrival and departure times and general activities (auditing, observing, etc.)

4.5.2 Sample Ticket Books

Preprinted sample ticket books with unique, sequential 6-digit ticket numbers will be assigned at the beginning of each sampling event. All pertinent information recorded on each sample container label (including the project, sampler, date and time of collection, and sample location ID) also will be recorded in the sample ticket book. Information such as unusual sampling conditions or other observations also may be recorded. A self-adhesive decal, printed and bar coded with the sample ticket number, will be removed from the sample ticket and affixed to the sample container label. The sample ticket books will serve as a field sample catalog and provide traceability of analytical data to sample locations.

4.5.3 Chain of Custody Form

The custody of individual sample containers will be documented by recording each container's identification and matrix on a Chain of Sample Custody form (GJO 1512), in accordance with the requirements specified in "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples", GN-9(P) (Appendix A).

These forms will be used to list all transfers of sample possession. These forms will become part of the permanent project file upon completion of fieldwork. Copies of the form received by the GJO Analytical Laboratory and the subcontracted facilities will be included in the final analytical report.

4.5.4 Request for Analytical Services Form

A request for Analytical Services form will be completed and submitted to the GJO Analytical Chemistry Laboratory for the environmental samples collected. The form provides the laboratory with the types of analyses to be performed on the identified samples.

4.5.5 Water-Sampling Field Data Form

A Water-Sampling Field Data Form will be used to record and document sample collection and identification information, purge volume calculations, indicator parameter measurements, purge and sampling equipment, and instrument calibration information. An example form is included in Procedure LQ-3(P), Appendix A. A copy of the completed forms will be submitted to the GJO Analytical Chemistry Laboratory for inclusion in the final analytical report.

4.5.6 Nonconformance and Corrective Action Procedure

Deviations from specified field protocols and/or sampling procedures established in planning documents or Standard Operating Procedures must be authorized by the Project Coordinator and fully documented by the Field Supervisor. Field variances will be reported in a timely manner for evaluation of impact to the data. Field variance reporting applies to deviations to (1) prescribed field sampling, measurement, or survey techniques; (2) specified shipping handling or storage requirements; and (3) decontamination procedures. A field logbook entry must be made whenever an activity is performed or sample is obtained that does not fall within the methods or protocols specified for sample, measurement or survey techniques, use of an instrument that is out of calibration or has failed and operational check, loss of traceability of sample, measurement or survey data to their location, noncompliance with established procedures, and/or loss of or damage to records that can not be duplicated.

The variance should be fully described (including an accurate reference to the document and section within the document that the activity varied), as well as the immediate corrective action taken, if applicable. Comments describing the variance will be used during sample processing and data evaluation to assess the use of associated results and validity of the data. For reference purposes, a table of contents for field variances will be established at the beginning of the logbook and will include the page number and a brief descriptive title for all field variance information that is documented in the logbook.

Field variances that may result in a nonconformance due to unacceptable or indeterminate sample or data quality, will be reported to the Quality Assurance (QA) Coordinator by the Project Manager. If corrective action is required, the field variance will be reported as a nonconformance. Proposed corrective action will be approved by the Project Manager and will be tracked and reviewed by the QA Coordinator. Nonconformance reporting and corrective action will be completed in accordance with the procedures specified in Criterion 3 of the GJ QA Manual (GJO 1).

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5.0 Quality Assurance

QA requirements for field and laboratory activities relevant to this plan are specified in procedure GN-6(P), "Standard Practice for Quality Assurance", (reference Appendix A). A Document Addition /Revision form has been prepared to clarify the applicability of certain requirements or to modify the requirement in order to apply a graded approach.

The QA Coordinator will review the Annual Monitoring Program and any subsequent revisions, through Program Directors, to ensure the applicable QA requirements are adequately addressed within the text or through procedures appended to the plan. Any changes to the application and grading of GN-6(P) for the sampling and analysis activities implemented through this plan will be facilitated and controlled by the QA Coordinator in accordance with the requirements established in procedure GN-1(P), "Standard Practice for Preparing or Revising Procedures for the GJO Environmental Procedures Catalog".

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6.0 References

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Appendix A

Field Sampling Procedures

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Environmental Procedures Catalog

Document Addition/Revision

Procedure Title Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells, [LQ-2(T)], Rev 2, 11/92.

Requester Sam Campbell

Justification To better define the measuring point location on the well casing. Actions to meet the instrument check requirements are defined. Time will not be recorded because it is not relevant.

Proposed Changes (list here or attach copies) Section 1.1 - If the casing is not marked with a measurement reference point, and the casing is not cut horizontal , measurements will be made from the high point on the casing. If the casing is not marked with a measurement reference point, and the casing is cut horizontally, measurement will be made from the north side of the casing. Section 8 - Instruments will be checked with a steel tape on an annual basis as a minimum. When performed, the check will be recorded in the field logbook. Section 16.1.1 - Time will not be recorded. Water-level measurements will be entered into an electronic hand-held data entry device.

New Document

Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned ____________

______________________________ ______________
Manager, Compliance Management *Date*

Project-Specific Change for Operable Unit III Annual Monitoring Program
Project

Reviewed by T.R. Brittett 2/25/97 Approved by Mark McClelland 2/25/97
Technical Author or Senior Proficient Designee *(date)* *Manager or Designee* *(date)*

Effective Date 4/1/97

GJO 1787
2/97

Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells

Introduction

Water-level measurements shall be taken prior to any sampling or well purging. These measurements are needed to determine the casing volume of water in the well; the data are used to interpret the monitoring results. High water levels could indicate recent recharge to the system, which would dilute the sample. Low water levels could reflect the influence of nearby production wells. Documentation of nonpumping water levels also provides historical information on the hydraulic conditions at the site (see reference 3.7).

1. Scope

1.1 Water levels shall be measured from the top of the well casing and, for consistency, shall always be made from the same spot on the well casing. If the planning documents do not specify a reference point, and other reference points do not exist, the measurement shall be made on the north side of the well casing.

1.2 Three methods are provided in this test method for water-level measurement.

1.2.1 The first method uses an electric water-level sounder with a conductivity cell. When the cell contacts water, it completes an electrical circuit, activating an audio and/or visual alarm.

1.2.2 The second method uses an interface probe. This instrument has an optical liquid sensor and a conductivity cell and can distinguish between the presence of a nonconductive layer and a conductive layer. For example, oils, fuels, and many organics are nonconductive and are immiscible with water. With an interface probe, the sampler can measure the thickness of a light non-aqueous-phase liquid (LNAPL) layer, which floats on the water's surface, or a dense non-aqueous-phase liquid (DNAPL) layer, which sinks to the bottom of the well.

1.2.3 The third method uses an electronic/pneumatic water-level meter in conjunction with a dedicated water-level probe. The water-level meter measures the pressure it takes to force the water out of the dedicated water-level probe and converts that pressure to the submersion depth of the probe. This depth is then subtracted from the total probe length (obtained during installation), giving the depth to water.

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Method C — Water-Level Measurements Using a Well Wizard Model 6010E Electronic/Pneumatic Water-Level Meter with a Dedicated Water-Level Probe	12–15

2. Hazard Analysis

2.1 Site-specific controls (e.g., radiological controls in a contaminated area, respirators, personal protective equipment, and decontamination) are available in the planning documents, such as the Health and Safety Plan, for a particular project. These documents should be consulted before beginning work on a project.

2.2 This test method uses methanol for decontaminating the apparatus. Methanol is a Department of Transportation (DOT)-regulated material; its hazard class is Flammable Liquid. Methanol has an Occupational and Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL)–Time-Weighted Average (TWA) of 200 parts per million (ppm) and a PEL-Short Term Exposure Limit (STEL) of 250 ppm (see reference 3.2). Methonal can also potentially enter the body through the skin.

2.2.1 Some of the effects of methonal by inhalation or skin absorption include dizziness, nausea, weakness, shooting pain in the arms or legs, gastric pain, blurred vision, changes in color perception, double vision, and blindness (see reference 3.3).

2.2.2 Avoid eye and skin contact by wearing eye protection and nitrile (including thin Best

N-Dex), butyl, or neoprene gloves. Avoid breathing vapors by using only in a well-ventilated area. Keep away from heat, sparks, and flames.

2.3 Method C involves use of an air compressor to charge the internal tank of the water-level meter. Safety precautions include:

2.3.1 Air compressors that are belt-driven shall have a belt guard in place.

2.3.2 Air compressors shall not be operated above the rated capacities and shall be configured to avoid having any dead-end fittings above 20 pounds per square inch (psi). Carefully check for loose connections before operating.

2.3.3 Use proper lifting techniques when lifting air compressors.

2.3.4 Ensure that the air compressor is equipped with an over-pressure relief valve and regulator.

2.3.5 The air compressors used for Method C are gasoline-powered.

2.3.5.1 Gasoline is a DOT-regulated material; its hazard class is Flammable Liquid. Gasoline has an OSHA PEL–TWA of 300 ppm and a PEL–STEL of 500 ppm (see reference 3.2).

2.3.5.2 Avoid eye and skin contact by wearing eye protection and nitrile or butyl gloves. Avoid breathing vapors by using only in a well-ventilated area. Keep away from heat, sparks, and flames.

2.3.5.3 Some of the symptoms of gasoline exposure include dizziness, intoxication, blurred vision, headache, skin irritation, and flushed facial skin tone (see reference 3.3).

2.3.5.4 Gasoline shall be stored in Factory Mutual-approved safety cans. Safety cans shall be well secured in the vehicle during transport. Gasoline-powered compressors must be cool before filling, and care shall be taken to avoid spilling any gasoline.

2.3.5.5 A 10-pound dry chemical fire extinguisher should be available when fueling the compressor.

3. Referenced Documents

3.1 *American Society for Testing and Materials, 1990 Annual Book of ASTM Standards*, Section 11, "Water and Environmental Technology," Vol. 11.04, Pesticides; Resource Recovery; Hazardous Substances and Oil Spill Responses; Waste Disposal; Biological Effects:

ASTM D 4448–85a—Standard Guide for Sampling Groundwater Monitoring Wells.

3.2 *Code of Federal Regulations* (CFR), Title 29, "Labor":

29 CFR 1910, Occupational Safety and Health Standards.

3.3 Micromedex, Inc., *TOMES Plus*, CD–ROM Database, Vol. 13, Chicago, IL, 1992.

3.4 QED Environmental Systems, Inc. *Well Wizard Model 6010E Electronic/Pneumatic Water Level Meter Installation and Operation Instructions.* Ann Arbor, MI, 1991.

3.5 U.S. Department of Energy, *The Environmental Survey Manual*, Appendix E, "Field Sampling Protocols and Guidance," Office of the Assistant Secretary, Environment, Safety and Health, Vol. 4, DOE/EH–0053, 1987.

3.6 U.S. Environmental Protection Agency, *Handbook of Groundwater*, EPA/625/6–87/016, 1987.

3.7 U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA/600/2–85/104, 1985.

4. Terminology

4.1 *Conductivity cell*—A simple electrical circuit that, when completed, causes electrical current to flow.

4.2 *Dedicated water-level probe*—A stainless steel probe permanently attached with polyethylene tubing to the cap of a well and used to obtain water-level information.

4.3 *Electric water-level sounder*—An electronic probe that uses a conductivity cell to activate an alarm when it contacts a conductive liquid.

4.4 *Electronic/pneumatic water-level meter*—A device that uses an internal compressed air source (pneumatic) to force air down the dedicated water-level probe. The meter senses the amount of pressure needed to push the water out of the dedicated water-level probe using a pressure transducer and associated circuitry and software (electronic). The meter converts this pressure to the depth of submersion of the probe.

4.5 *Interface probe*—A probe designed to detect conductive and nonconductive layers in a well.

4.6 *Monitoring well*—A well installed for the purposes of obtaining water quality data, hydrogeologic information, and/or water-level data.

5. Significance and Use

5.1 Accurate measurements of water depth are necessary in the calculation of well bore volumes; measurements to the nearest 0.01 foot (ft) are routine.

Method A
Water-Level Measurements Using an Electric Sounder

6. Apparatus

6.1 Electric sounder. (There are many adequate electric sounders available. This procedure covers most models.)

6.2 Kimwipes or equivalent lint-free tissue.

6.3 Distilled or deionized water in a squeeze wash bottle.

6.4 Measuring tape with an engineering scale.

7. Procedure

7.1 The following procedure is supplemental to the instruction found in the instrument-specific operating manual:

7.1.1 Check the sounder to ensure the batteries are charged.

7.1.2 Clean the probe of the sounder with distilled or deionized water and wipe dry with a lint-free tissue.

7.1.3 Slowly lower the probe into the well until the indicator sounds.

7.1.4 Raise the probe slightly until the indicator stops sounding.

7.1.5 Carefully lower the probe until the indicator sounds again and read the depth to water to the nearest 0.01 ft, using a measuring tape with an engineering scale if necessary.

7.1.6 Repeat steps 7.1.4 and 7.1.5 until a repeatable measurement is achieved.

7.1.7 Record the depth to water to the nearest 0.01 ft.

7.1.8 Slowly withdraw the probe from the well while wiping the cable with a lint-free tissue moistened with distilled or deionized water.

7.1.9 Clean the probe with distilled or deionized water and wipe dry with a lint-free tissue.

8. Procedure Bias

8.1 With this method, water-level measurements must be repeatable to ± 0.01 ft. The accuracy of the probe shall be routinely checked against a steel measuring tape to ensure that the cable has not stretched or twisted.

Method B
Water-Level Measurements Using an Interface Probe

9. Apparatus

9.1 Soiltest Model 447–000 Interface Probe or equivalent.

9.2 Kimwipes or equivalent lint-free tissue.

9.3 Distilled or deionized water in a squeeze wash bottle.

9.4 Methanol

10. Procedure

10.1 The following procedure is supplemental to the instruction found in the instrument-specific operating manual:

10.1.1 Clean the probe with methanol, followed by a distilled or deionized water rinse, and wipe dry with a lint-free tissue.

10.1.2 Check the battery level and replace if low.

10.1.3 Slowly lower the probe into the well until the probe comes in contact with liquid. A steady audible alarm indicates an immiscible, nonconductive liquid, while an oscillating alarm indicates a conductive liquid (water).

10.1.4 When the alarm sounds, raise the probe slightly until the alarm stops. Carefully lower until the alarm sounds again and note the depth. Repeat as necessary until a repeatable measurement of ± 0.01 ft is achieved. Record this measurement.

10.1.5 If a LNAPL layer is present as indicated by a steady audible alarm, the thickness can be measured by recording the point at which the steady alarm begins and the point at which the oscillating alarm begins. The difference between the two measurements is the thickness of the LNAPL layer.

10.1.6 If a DNAPL layer is suspected, it can be measured by slowly lowering the probe to the bottom of the well. If a DNAPL layer is present, the thickness can be measured by recording the difference between the point at which the steady alarm begins and the point at which the probe reaches the bottom of the well.

10.1.7 Carefully withdraw the probe from the well while wiping the cable with a lint-free tissue moistened with distilled or deionized water. If the well contained any LNAPL layers, the cable shall be rinsed with methanol followed by a distilled or deionized water rinse and wiped dry with a lint-free tissue as it is being removed from the well.

10.1.8 Clean the probe with methanol, followed by a distilled or deionized water rinse, and dry with a lint-free tissue.

11. Procedure Bias

11.1 When using the interface probe for liquid level measurements, readings of ± 0.01 ft can be achieved. The accuracy shall be routinely checked using a steel measuring tape to determine if the cable has stretched or twisted.

Method C
Water-Level Measurements Using a Well Wizard Model 6010E Electronic/Pneumatic Water-Level Meter with a Dedicated Water-Level Probe

12. Apparatus

12.1 Well Wizard Model 6010E electronic/ pneumatic water-level meter.

12.2 Well Wizard Model 6111 stainless steel water-level probe and associated polyethylene tubing, fittings, and cap assembly.

12.3 Well Wizard Model 6015 calibration assembly.

12.4 Well Wizard 41000 series oil-free compressor or equivalent.

13. Procedure

13.1 The following procedure is supplemental to the instruction found in the instrument-specific operating manual (see reference 3.4):

13.1.1 Rapid temperature changes will adversely affect the water-level meter operation. The meter must equilibrate to ambient temperature conditions for a minimum of 45 minutes before use.

13.1.2 Charge the internal tank of the water-level meter to 100 psi by attaching an oil-free air supply to the fitting marked "TANK RECHARGE."

13.1.3 Move the "SENSOR" switch to the "ON" position.

13.1.4 Wait for the liquid crystal display (LCD) message to read "ATTACH TO WELL."

13.1.5 Attach the meter air tubing from the water-level meter fitting marked "TO AIR PROBE" to the white air fitting on the well cap.

13.1.6 Move the "AIR" switch forward to the "ON" position.

13.1.7 Press the "START" button once.

13.1.8 Press the "AIR PRECHARGE" until the LCD display shows the highest reading.

13.1.9 Leave the "AIR" switch in the "ON" position. The LCD message will read "PROBE SUBMERSION DEPTH B," and the reading shall be recorded when the depth stabilizes.

13.1.10 Move the "AIR" and "SENSOR" switches back to the "OFF" position.

13.1.11 To determine the depth to water, subtract the probe submersion depth from the probe length determined during installation.

13.1.12 When the batteries begin to get low, the LCD message will read "WARNING! LOW BATTERIES" after pressing the "START" button. Pressing the "START" button again will allow additional limited use, but the batteries must be replaced soon.

13.1.13 If the LCD message reads "BATTERY TOO LOW! TURN SYSTEM OFF," the meter shall not be used until the batteries are replaced.

14. Calibration

14.1 This calibration procedure shall be performed before each round of water-level measurements.

14.1.1 Place water in the calibration test tube to a convenient level on the scale marked on the side of the tube.

14.1.2 Charge the internal tank of the water-level meter to 100 psi by attaching an oil-free air supply to the fitting marked "TANK RECHARGE."

14.1.3 Move the "SENSOR" switch to the "ON" position.

14.1.4 Wait for the LCD message to read "ATTACH TO WELL."

14.1.5 Attach the meter air tubing from the water-level meter fitting marked "TO AIR PROBE" to the air fitting on the top of the calibration test tube.

14.1.6 Move the "AIR" switch forward to the "ON" position.

14.1.7 Press the "START" button once.

14.1.8 Press the "AIR PRECHARGE" button until the LCD display reads the highest number.

14.1.9 Move the "AIR" switch back to the "OFF" position.

14.1.10 Wait for the LCD message to read "PROBE SUBMERSION DEPTH" and for the depth reading to stabilize.

14.1.11 Compare the meter reading to the actual water level in the calibration test tube. If the meter does not read the actual water level observed in the calibration test tube, remove the "CALIBRATION" panel screw and the epoxy seal from the internal calibration screw.

14.1.12 Slowly adjust the internal calibration screw until the meter reading matches the actual water level observed in the calibration test tube.

14.1.13 Repeat steps 14.1.3 through 14.1.11 to check the calibration.

14.1.14 Apply a small amount of epoxy or a similar locking compound to the calibration screw to lock it into position.

14.1.15 Reinstall the meter "CALIBRATION" panel screw.

15. Procedure Bias

15.1 The accuracy of this system of water-level measurements is ± 0.01 ft between 40 °F and 120 °F, and ± 0.02 ft between –20 °F and 40 °F.

16. Quality Assurance

16.1 The following information shall be logged when taking water-level measurements:

16.1.1 Date and time of measurements.

16.1.2 Well identification and site.

16.1.3 Name of person performing the measurement.

16.1.4 Reference point if not top of casing.

16.1.5 Remarks if necessary, e.g., wells pumping nearby, recent heavy rains, ice in well.

16.1.6 Depth to water.

16.1.7 Depths to top of LNAPLs and DNAPLs and thicknesses of layers (Method B only).

16.1.8 Length of dedicated water-level probe (Method C only).

16.1.9 Depth of submersion of water-level probe (Method C only).

16.1.10 Date and time of calibration and any calibration adjustments made (Method C only).

17. Keywords

17.1 Calibration test tube, conductivity cell, dedicated water-level probe, electric sounder, electronic/pneumatic water-level meter, interface probe, monitoring well, and probe submersion depth.

Environmental Procedures Catalog

Document Addition/Revision

Procedure Title Standard Practice for Purging of Monitoring Wells, [LQ-3(P)], Rev 1, 4/92

Requester Sam Campbell

Justification (1) To establish project specific well purging/monitoring procedures. (2) To establish project specific policy regarding monitor well purge water.

Proposed Changes (list here or attach copies) (1)Specific purge volume calculation and parameter stability criteria are defined in Section 3.2 of the Annual Monitoring Program. (2) Purge water evacuated from millsite and downgradient groundwater sampling wells will be collected and disposed in Pond 3 or in the drain of the decontamination pad at the east enterance of the millsite, which drains into Pond 3.

New Document

Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned ________

____________________ __________

Manager, Compliance Management *Date*

Project-Specific Change for Operable Unit III Annual Monitoring Program
Project

Reviewed by TE Bartlett 2/25/97 Approved by [signature] 2/25/97
Technical Author or Senior Proficient Designee *(date)* *Manager or Designee* *(date)*

Effective Date 4/1/97

GJO 1787
2/97

Standard Practice for Purging of Monitoring Wells

Introduction

To obtain a representative groundwater sample, the stagnant water in the well casing shall be removed. The recommended amount of purging depends on many factors such as the hydrogeological nature of the aquifer, the characteristics of the well, the type of sampling equipment to be used, and the parameters to be sampled. There is no one standard that will fit all situations. The general rule-of-thumb is to monitor the purge water using an in-line flow cell for pH, conductivity, and temperature. When these parameters stabilize to ± 10 percent for two successive well volumes, the sampler can be reasonably assured that the stagnant water has been removed from the well casing.

1. Scope

1.1 The four methods provided here are representative of those generally used to purge monitoring wells. Each method has advantages and disadvantages that must be considered. A review of Section 7, "Well Purging Strategies," General Considerations for the Sampling of Liquids [LQ-1(G)] (reference 3.2), provides guidance for selecting the proper method.

	Section
Method A—Well Purging Using a Peristaltic-Type Pump	6–8
Method B—Well Purging Using a Bladder-Type Pump	9–11
Method C—Well Purging Using a Bailer	12–14
Method D—Well Purging Using a Submersible Pump	15–17

2. Hazard Analysis

2.1 These procedures use gasoline-powered electric generators, gasoline-powered air compressors, and battery-powered pumps and accessories. The following safety precautions shall be followed.

2.1.1 Air compressors that are belt driven shall have a belt guard in place.

2.1.2 Care shall be taken when connecting and disconnecting equipment powered by lead-acid batteries to avoid generating sparks that have the potential of creating an explosive hazard.

2.1.3 Gasoline shall be stored in Factory Mutual (FM)-approved safety cans. Safety cans shall be well secured in the vehicle during transport. Gasoline-powered equipment shall be cool before filling and care shall be taken not to spill any gasoline.

2.1.4 Air compressors shall not be operated above rated capacities and shall be configured to avoid having any dead end fittings above 20 pounds per square inch (psi). Carefully check for loose connections before operating.

2.1.5 Gasoline is a Department of Transportation (DOT)-regulated material; its hazard class is Flammable Liquid. Avoid eye and skin contact by wearing eye protection and disposable gloves. Avoid breathing vapors. Use only in a well-ventilated area and keep away from heat, sparks, and flames.

2.1.6 Gasoline-powered generators shall not be operated above their rated capacity.

2.1.7 Care shall be used when lifting generators and air compressors. Proper lifting techniques shall be used when lifting heavy equipment.

2.1.8 Site-specific controls are available in the planning documents for a particular project.

3. Referenced Documents

3.1 American Society for Testing and Materials, *Standard Guide for Sampling Groundwater Monitoring Wells*, D4448–85a, 1986.

3.2 Geotech, *Environmental Procedures Catalog* (Manual 116):

General Considerations for the Sampling of Liquids [LQ-1(G)],

Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells (LQ-2(T)].

Standard Practice for the Use of a Flow Cell for Field Measurements [LQ-10(P)].

3.3 U.S. Department of Energy, *The Environmental Survey Manual*, Appendix E, Volume 4, DOE/EH-0053 1987.

3.4 U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA/600/2–85/104, 1985.

3.5 U.S. Environmental Protection Agency, *Handbook Groundwater*, EPA/625/6–87/016, 1987.

4. Significance and Use

4.1 Water may become stagnant in a well and will not reflect the local resident water's chemical and physical properties. The purging of a well can reduce this bias. Care shall be taken to allow screened intervals to come to equilibrium before sampling is performed

5. Calculation of Volume of Standing Water in a Well

5.1 Calculations are performed for the amount of water in the well with the following formula:

$$r^2 \times \pi \times (h1 - h2) \times 7.48 = \text{gallons per casing volume,} \quad (1)$$

where

r = radius of well casing (feet) (the radius of the well is obtained from the well completion logs or can be measured with a tape measure),

h1 = depth of well (feet) from the top of the well casing (the depth of the well is obtained from the well completion logs), and

h2 = depth to water (feet) measured from the top of the well casing (the depth of water is measured using the Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells [LQ–2(T)]).

Method A
Well Purging Using a Peristaltic-Type Pump

6. Apparatus

6.1 Peristaltic-type pump.

6.2 Silicone, C-FLEX, or neoprene tubing for the pump head.

6.3 Silicone, Teflon, polyethylene, or vinyl tubing for placing in the well.

6.4 Generator or other source of electricity.

6.5 Gasoline for generator. (Gasoline is a DOT-regulated material; its hazard class is Flammable Liquid.)

7. Procedure

7.1 The following procedure is supplemental to the instruction in the instrument-specific operating manual.

7.1.1 Place the suction line in the well so it is just below the liquid surface.

7.1.2 Connect the suction line to the pump.

7.1.3 Connect the pump outlet to the in-line flow cell, see reference 3.2, or place the pump outlet hose into an open container to be used to make the field measurements.

7.1.4 Place calibrated pH, conductivity, and temperature electrodes into the in-line flow cell or the open container.

7.1.5 Initiate pumping and follow the water level down the well bore if the recovery rate of the well is below the pumping rate.

NOTE: Purge water may have to be contained and properly disposed of. Consult the site-specific planning documents for requirements.

7.1.6 Routinely monitor and record the volumes purged and the readings for the pH, conductivity, and temperature.

7.1.7 When these readings have stabilized to ± 10 percent for two successive well volumes, sampling can begin.

7.1.8 Remove the suction line from the well, and clean and decontaminate the suction line and pump tubing, as required.

8. Procedure Bias

8.1 The advantages of purging with a peristaltic pump are that (1) a peristaltic pump is relatively portable, inexpensive, and convenient; (2) it requires a minimum of down-hole equipment; and (3) it can be cleaned easily or the entire tubing can be changed between wells.

8.2 The disadvantages of purging with a peristaltic pump are that (1) purging is limited to situations where the water levels are less than about 25 feet and (2) degasing occurs whenever there is a head difference between the pump and the water level.

Method B
Well Purging Using a Bladder-Type Pump

9. Apparatus

9.1 Bladder-type pump.

9.2 Air compressor.

9.3 Teflon, polyethylene, or vinyl tubing for the air and sample line.

9.4 Gasoline for the air compressor. (Gasoline is a DOT-regulated material; its hazard class is Flammable Liquid.)

10. Procedure

The following procedure is supplemental to the instruction found in the instrument-specific operating manual.

10.1 Lower the pump gently to a position just above the screened interval.

10.2 Connect the air line to the pump controller.

10.3 Connect the pump outlet to an in-line flow cell; see Standard Practice for the Use of a Flow Cell for Field Measurements [LQ–10(P)].

10.4 Place calibrated pH, conductivity, and temperature electrodes in the flow cell or the open container.

10.5 Initiate pumping and routinely monitor and record the volume purged and the pH, conductivity, and temperature measurements.

NOTE: Purge water may have to be contained and properly disposed of. Consult the site-specific planning documents for requirements.

10.6 When these readings have stabilized to ± 10 percent for two successive well volumes, sampling can begin.

10.7 Remove the pump from the well, clean and decontaminate as required.

11. Procedure Bias

11.1 The advantages of using a bladder-type pump for purging are that (1) the system is not damaged by dry pumping, (2) there is no air/water contact, and (3) the entire assembly can be made of Teflon or stainless steel.

11.2 The disadvantages of using a bladder-type pump are that (1) pumping rates are relatively slow, (2) there is a high rate of air consumption during prolonged pumping, and (3) cleaning and decontamination are more difficult than with the apparatus used in methods A or C.

Method C
Well Purging Using a Bailer

12. Apparatus

12.1 Teflon or stainless steel bailer.

12.2 Teflon or stainless steel cable or line.

12.3 Bailer reel.

13. Procedure

13.1 Attach the bailer to the cable or line.

13.2 Lower the bailer slowly until it contacts the liquid.

13.3 Allow the bailer to sink until it is totally submerged.

13.4 Slowly raise the bailer to the surface.

13.5 Tip the bailer or use a bottom-emptying device and fill a container in which calibrated pH, conductivity, and temperature probes have been placed.

NOTE: Purge water may have to be contained and properly disposed of. Consult the site-specific planning documents for requirements.

13.6 Routinely monitor and record the pH, conductivity, temperature, and volume purged.

13.7 When the readings have stabilized to ± 10 percent for two successive well volumes, sampling can begin.

13.8 Clean and decontaminate the bailer, as required.

14. Procedure Bias

14.1 The advantages of using bailers for well purging are that (1) bailers can be constructed of a variety of materials, (2) external power sources are not needed, (3) bailers are inexpensive, (4) bailers are easily cleaned and decontaminated, and (5) bailers can be used in wells of virtually any depth.

14.2 The disadvantages of using bailers are that (1) evacuating large amounts of stagnant water is labor intensive; (2) aeration, degasing, and turbulence will occur; (3) it is difficult to determine the depth to which the bailer has been submerged; and (4) bailer check valves may not operate properly under conditions of high suspended solids.

Method D
Well Purging Using a Submersible Pump

15. Apparatus

15.1 Submersible-type pump.

15.2 Discharge tubing of vinyl, polyethylene, polyvinyl chloride, or Teflon.

15.3 Power source of generator or batteries.

15.4 Gasoline for generator. (Gasoline is a DOT-regulated material; its hazard class is Flammable Liquid.)

16. Procedure

The following procedure is supplemental to the instructions provided in the instrument-specific operating manual.

16.1 Set up the pump according to the operating manual.

16.2 Gently lower the pump down the well so that the pump head is submerged sufficiently and will not run dry.

CAUTION: Submersible pumps cannot be allowed to run dry.

16.3 Connect the pump outlet to an in-line flow cell; see Standard Practice for the Use of a Flow Cell for Field Measurements ([LQ–10(P)].

16.4 Place calibrated pH, conductivity, and temperature electrodes in the flow cell or the open container.

16.5 Initiate pumping, and monitor and record the volumes purged and the pH, conductivity, and temperature measurements.

NOTE: Purge water may have to be contained and properly disposed of. Consult the site-specific planning documents for requirements.

16.6 When pH, conductivity, and temperature have stabilized for two successive well volumes, sampling can begin.

16.7 Remove the pump from the well; clean and decontaminate.

17. Procedure Bias

17.1 The advantages of using a submersible pump for well purging are that (1) relatively high pumping rates are possible, (2) some designs are relatively portable and easy to use, and (3) these pumps can pump from greater depths than the pumps used in methods A or B.

17.2 The disadvantages of using a submersible pump are that (1) high pumping rates and the mechanical actions cause turbulence, aeration, and degasing of the water; (2) pumps are easily damaged by dry pumping; and (3) these pumps can be difficult to clean and decontaminate.

18. QualityAssurance

18.1 All of the methods listed above require the following information to be logged for quality-assurance documentation.

18.1 Depth to water.

18.2 Depth of well.

18.3 Well diameter or radius.

18.4 Depth of water.

18.5 Calculated water volume.

18.6 Type of mechanism used to evacuate the well.

18.7 Date.

18.8 Well identification.

18.9 Name of person performing the purging.

18.10 Volume purged.

18.11 Conductivity, pH, and temperature measurements.

19. Keywords

19.1 Bailer, bladder-type pump, peristaltic-type pump, submersible pump, and well purging.

Standard Test Method for the Field Measurement of pH

Introduction

Perhaps no water-quality parameter is measured as frequently as pH. The pH measurement is so easily made that the attention given to it is often inadequate. An accurate pH is critical for the prediction and interpretation of the reactions and migration of dissolved species. This procedure provides a useful pH measurement under most field situations.

1. Scope

1.1 This is the procedure for the measurement of pH in an aqueous solution. The pH is determined using a glass hydrogen-ion electrode compared against a reference electrode of known potential by means of a pH meter.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the planning documents of a particular project.

3. Referenced Documents

3.1 American Society for Testing and Materials, *Annual Book of ASTM Standards*, Section 11, Volume 11.01, D1293–78, 1984.

3.2 American Public Health Association, American Water Works Association, and Water Pollution Control Federation, *Standard Methods for the Examination of Water and Wastewater: American Public Health Association*, Washington, D.C., 1980.

3.3 Geotech, *Environmental Procedures Catalog*, Manual 116:

Standard practice for the Use of the Flow Cell for Field Measurements [LQ–10(P)].

3.4 Korte, N., and D. Ealey, *Procedures for Field Chemical Analyses of Water Samples*, Technical Measurements Center, U.S. Department of Energy, Grand Junction Area Office, GJ/TMC–07(83), 1983.

3.5 Wood, W.W., "Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents," *Techniques of Water-Resources Investigations of the United States Geological Survey*, Chapter D2, Book 1: U.S. Government Printing Office, Washington, D.C., Stock Number 024–001–02879–4, 1976.

4. Significance and Use

4.1 The pH of a solution is defined as the negative logarithm to the base 10 of the hydrogen-ion activity in moles per liter: $pH = -\log [H^+]$. Because pH is exponentially related to concentration, great care shall be taken in making the measurement.

4.2 Natural waters usually have pH values in the range of 4 to 9. The primary control over pH in natural waters is the carbonate system, including gaseous and dissolved carbon dioxide, bicarbonate, and carbonate ions.

5. Interferences

5.1 Temperature, atmospheric contamination, and ionic strength are factors that affect pH measurements. The pH measurement is relatively free from interference from color, turbidity, colloidal matter, oxidants, or reductants.

5.1.1 *Temperature*—The temperature compensation on a pH meter only permits adjustment of the electrode slope. It does not compensate for changes in the potential of the reference electrode, the asymmetry potential of the glass electrode, or the liquid-junction potential. Nor does it compensate for changes in pH due to temperature. Thus, the temperature of the buffer and the unknown shall be recorded at the time of measurement. Ideally, their temperatures shall be within 10 °C.

5.1.2 *Atmospheric Contamination*—Atmospheric contamination can be a significant problem for groundwater samples. Dissolved oxygen and carbon dioxide can be evolved or dissolved when the sample is exposed to air, and a considerable change in pH may result. In situ measurements should be taken where possible but, for groundwater that must be pumped, the use of a flow cell gives the best results. See Standard Practice for the Use of a Flow Cell for Field Measurements [LQ–10(P)].

5.1.3 *Ionic Strength*—Because of errors due to ionic strength (which are not worth correcting in the field), pH measurements shall be accompanied by a measurement of the specific conductance. The pH is a measurement of the hydrogen-ion activity. An ideal solution is assumed in which other ions do not affect the hydrogen activity. This assumption deteriorates if the ionic strength is too high. Similarly, samples with low ionic strength will cause difficulties because the resistance of the sample approaches that of the glass electrode. For best results, samples with very low ionic strength should be stirred for a few seconds prior to the reading. Even then, it may require several minutes for the reading to stabilize.

5.1.4 *High Sodium and Alkalinity*—High sodium and alkalinity may also produce errors in the pH measurement. For pH 9 and a sodium concentration of 10 moles per liter, a special electrode is needed. Similarly, any pH value that is less than 1 or greater than 9 will have a greater uncertainty associated with it because the electrode response is non-Nernstian in these regions.

6. Apparatus

6.1 Numerous pH meters are available; the meter used should have a temperature compensating device have a slope adjustment and be capable of reading pH to ± 0.01 units.

6.2 A flow cell to be used for continuous-flow measurements.

6.3 Standard pH-buffer solutions of 4.00, 7.00, and 9.00 or 10.00.

6.4 Combination pH electrode.

6.5 Temperature-measuring device capable of reading temperatures to ± 0.1 °C.

6.6 Distilled or deionized water in a squeeze wash bottle.

6.7 Kimwipes or equivalent lint-free tissue.

6.8 Disposable beakers, test tubes, or centrifuge tubes.

7. Calibration

7.1 In each case, samplers shall follow the manufacturer's instructions for the pH meter and electrode used. Electrodes shall be kept wet when not in use. Recommended solutions for storage are the pH 4.00 or pH 7.00 buffer.

7.2 Before use, remove the electrode from the storage solution, rinse with distilled water, and blot dry with a lint-free tissue.

7.3 Adjust buffer solution and electrode to ± 10 °C of the sample temperature. This can be done by storing the buffer solutions and electrode in an ice chest or by letting sample water run over the buffer bottles and electrode until the temperatures have equilibrated.

7.4 Place the electrode in the pH 7.00 buffer, adjust the temperature compensation control to the temperature of the buffer (or use an automatic temperature compensator), and adjust the calibration control to read the pH of the buffer. The pH of the buffer is equal to 7.00 only at 25 °C; therefore, it is necessary to use the temperature-correction curve supplied by the manufacturer of the buffer.

7.5 Remove the electrode from the 7.00 buffer, rinse with distilled water, and blot dry. Place the electrode in either pH 4.00 or pH 10.00 buffer, bracketing the expected pH of the sample. Allow the reading to stabilize before making adjustments. Adjust the slope control to read the correct pH, again consulting the temperature-correction curve supplied by the manufacturer.

7.6 Rinse the electrode with distilled water and blot dry. Recheck value of the pH 7.00 buffer. The value shall be within ± 0.02 pH of the correct value. If not, repeat steps 7.4, 7.5, and 7.6.

8. Procedure

8.1 The following general procedure supplements the instruction in the instrument-specific operating manual.

8.1.1 Rinse the calibrated electrode (see Section 7) with distilled water, blot dry, and immerse electrode in the solution.

8.1.2 Use of a flow cell is recommended for making pH measurements; this reduces the interferences due to atmospheric contamination. If possible, in situ measurements are the best.

8.1.3 Allow the measurement to stabilize and record the reading.

8.1.4 Remove the electrode from the solution, rinse with distilled water, blot dry, and store in pH 4.00 or pH 7.00 buffer solution.

9. Quality Assurance

9.1 The following information about the field measurement of pH shall be logged for quality-assurance documentation.

9.1.1 Time of the last two-buffer calibration. The two-buffer calibration shall be performed a minimum of once each hour.

9.1.2 Buffer temperature at time of calibration.

9.1.3 Sample temperature at time of measurement.

9.1.4 Measurement conditions (i.e., in situ, open container, or air-exclusion container).

9.1.5 Source and expiration date of buffers used.

9.1.6 Instrument manufacturer and model number.

9.1.7 Name of person performing the measurement.

10. Precision and Bias

10.1 Precision of ± 0.02 pH units and an accuracy of ± 0.05 pH units can be achieved. However, ± 0.1 pH units represent the limit of accuracy under normal conditions.

11. Keywords

11.1 Electrode, flow cell, pH, and pH meter.

Environmental Procedures Catalog

Document Addition/Revision

Procedure Title Standard Test Method for the Field Measurement of Specific Conductance [LQ-5(T)], Rev. 1, 4/92

Requester Sam Campbell

Justification A three point operational check is required to determine if the instrument is responding properly through a wide range of conductivities. However, this three point check is not necessary at every sampling site due to the limited range of conductivities expected.

Proposed Changes (list here or attach copies) Section 7 - A three point conductivity check will be performed on each probe at the start of the sampling day. After the initial check, a one point check with a 1000 umhos/cm solution will be performed at each sampling location prior to sampling. The three point check may also be conducted using commercially available KCl solutions of 100 umhos/cm, 1000 umhos/cm and 10,000 umhos/cm.

New Document

Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned __________

Manager, Compliance Management *Date*

Project-Specific Change for Operable Unit III Annual Monitoring Program
Project

Reviewed by TE Bartlett 2/25/97 Approved by [signature] 2/25/97
Technical Author or Senior Proficient Designee *(date)* *Manager or Designee* *(date)*

Effective Date 4/1/97

GJO 1787
2/97

Standard Test Method for the Field Measurement of Specific Conductance

Introduction

Specific conductance is a widely used indicator of water quality. It measures the ability of water to carry an electrical current under specific conditions. This ability depends on the presence of ions and their total concentration, mobility, and temperature. Specific conductance is a simple indicator of change within a system and is used as an aid in evaluating whether a sample is representative of the water in the system.

1. Scope

1.1 This procedure describes the field measurement of the specific conductance of an aqueous sample. The specific conductance is measured using a conductance meter and a platinum or stainless steel electrode.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are availabl : in the planning documents for a particular projec..

3. Referenced Documents

3.1 American Public Health Association, American Water Works Association, and Water Pollution Control Federation, *Standard Methods for the Examination of Water and Wastewater: American Public Health Association*, Washington, D.C., 1980.

3.2 Korte, N. and D. Ealey, *Procedures for Field Chemical Analyses of Water Samples*, Technical Measurements Center, U.S. Department of Energy, Grand Junction Area Office, GJ/TMC–07(83), 1983.

3.3 Wood, W.W., "Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents," *Techniques of Water-Resources Investigations of the United States Geological Survey*, Chapter D2, Book 1: U.S. Government Printing Office, Washington, D.C., Stock Number 024–001–02879–4, 1976.

4. Significance and Use

4.1 The specific conductance or conductivity of a sample is defined as the conductance of the sample between opposite sides of a cube, 1 centimeter (cm) in each direction. Because it is impractical to build electrodes with these characteristics, electrodes are manufactured in various forms. A cell constant is determined by measuring a solution of known conductivity. Solutions of known conductivity are purchased or can be made from reagent-grade KCl. Samplers shall consult operating instructions for the specific instrument used for the determination of the cell constant. This conductivity is expressed in micromhos per centimeter (μmhos/cm).

5. Intereferences

5.1 Temperature, ionic strength, and the determination of the cell constant are features that affect the measurement of conductivity.

5.1.1 *Temperature*—The conductivity of a solution increases with temperature at approximately 2 percent per degree celsius. Significant errors can result from inaccurate temperature measurements.

5.1.1.1 If the conductivity meter does not have automatic temperature correction, the sampler can use the following formula to correct the conductivity reading for temperature:

$$K = \frac{Em}{1 + 0.0191(t - 25)}, \qquad (1)$$

where

K = corrected conductivity in μmhos/cm,

Em = measured conductivity in μmhos/cm, and

t = temperature in °C.

5.1.2 *Ionic Strength*—The conductivity of a solution is a function of the concentration and charge of the ions in solution and of the rate at which the ions move under the influence of an electrical potential. As the ionic strength increases, the rate at which the individual ions move decreases. Conductivity varies linearly with ionic strength for values below 1,000 μmhos/cm. As conductivity increases above 5,000 μmhos/cm, the line curves significantly; beyond 50,000 μmhos/cm, the conductivity is an unsatisfactory index of ionic concentration.

5.1.3 *Cell Constant*—The cell constant shall be checked and verified on a regular basis. A significant change in the cell constant indicates that the electrode needs cleaning or changing. Consult the instrument operating manual for procedures to check the cell constant, or see Section 7 of this procedure.

6. Apparatus

6.1 Specific conductance meter capable of measuring conductivity in the range of 0 to 100,000 μmhos/cm. This meter should also measure temperatures in the range of –5 °C to 50 °C.

6.2 Conductivity check solutions. Normally, 0.001 N, 0.01 N, and 0.1 N KCl solutions will cover the range of expected sample conductivity.

6.3 Distilled or deionized water in a squeeze bottle.

6.4 Disposable beakers, test tubes, or centrifuge tubes.

6.5 Kimwipes or equivalent lint-free tissue.

7. Calibration

7.1 An actual calibration of the instrument is not performed. The cell/instrument calibration is confirmed by use of standard check solutions as described below.

7.1.1 Connect the temperature probe and conductivity cell to the instrument.

7.1.2 Rinse the temperature probe and conductivity cell with distilled water and blot dry with a lint-free tissue.

7.1.3 Place the temperature probe and conductivity cell in the 0.001 N KCl standard and allow the readings to stabilize. Record the temperature and conductivity reading in the field logbook.

7.1.4 Repeat steps 7.1.2 and 7.1.3 for the 0.01 N and the 0.1 N KCl standards.

7.1.5 Correct the readings to 25 °C using the formula in Section 5.1.1.1 and compare these readings to the standard values. If these readings are within ± 10 percent of the accepted value, the cell instrument-calibration check is acceptable.

7.1.6 If the cell/instrument calibration check is unacceptable, consult the instrument operation manual for cell cleaning and instrument troubleshooting procedures.

8. Procedure

8.1 The following general procedure is supplemental to the instructions in the instrument-specific operating manual.

8.1.1 Rinse the conductivity cell and temperature probe with several volumes of sample water.

8.1.2 Immerse the probe and cell in the sample.

8.1.3 Allow the readings to stabilize and record the temperature and conductivity readings on the field log form.

8.1.4 Remove the probes from the solution, rinse with distilled water, blot dry, and store according to the manufacturer's recommended procedures.

9. Quality Assurance

9.1 The following information about the field measurement of specific conductance shall be logged for quality-assurance documentation.

9.1.1 Source and expiration date of standards.

9.1.2 Instrument manufacturer and model number.

9.1.3 Date and time of calibration check.

9.1.4 Temperature and conductivity of standards used to check calibration.

9.1.5 Sample temperature and conductivity reading.

9.1.6 Name of person performing the measurement.

10. Precision and Bias

10.1 Precision and accuracy of ± 5 percent can be achieved with this procedure at conductivity readings between 100 and 5,000 μmhos/cm.

Readings between 0 and 100 μmhos/cm and above 5,000 μmhos/cm should provide ± 10 percent precision and accuracy. Readings above 20,000 μmhos/cm shall not be attempted with this procedure.

11. Keywords

11.1 Conductivity, ionic strength, and specific conductance.

Standard Test Method for the Field Measurement of Alkalinity

Introduction

The alkalinity of a water sample is a quantitative measurement of the ability of the sample to react with a strong acid to a designated pH. The alkalinity of natural waters is primarily a measure of the carbonate, bicarbonate, and hydroxide content. It is also a general indicator of groundwater quality.

1. Scope

1.1 This method describes the field measurement of alkalinity of aqueous samples. It is a measure of the aggregate property of the sample and can be interpreted in the terms of specific substances, such as carbonate and bicarbonate, only when the chemical composition of the sample is known.

1.2 The sample is titrated with a standard acid solution to a designated pH, and the end point is determined by a color change of an internal indicator.

2. Hazard Analysis

2.1 This test procedure uses sulfuric acid (H_2SO_4). Sulfuric acid is a corrosive material and is a Department of Transportation (DOT)-regulated material; its hazard class is Corrosive Liquid. Avoid contact with eyes, skin, and clothing. Adequate ventilation, eye protection, and disposable gloves are required. First aid for eye and skin contact is to immediately flush with water for 15 minutes, remove contaminated clothing, and call a physician.

2.2 Site-specific controls are available in the planning documents for a particular project.

3. Referenced Documents

3.1 American Public Health Association, *Standard Methods for the Examination of Water and Wastewater*, American Water Works Association, and Water Pollution Control Federation, Washington, D.C., 1980.

3.2 American Society for Testing and Materials, *Annual Book of ASTM Standards*, Section 11, Volume 11.01, 1984.

3.3 Geotech, *Environmental Procedures Catalog* (Manual 116):

Standard Test Method for the Field Measurement of pH [LQ-4(T)].

3.4 Korte, N., and D. Ealey, *Procedures for Field Chemical Analyses of Water Samples*, Technical Measurements Center, U.S. Department of Energy, Grand Junction Area Office, GJ/TMC-07(83), 1983.

3.5 Wood, W. W., "Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents," *Techniques of Water-Resources Investigations of the United States Geological Survey*, Chapter D2, Book 1: U.S. Government Printing Office, Washington, D.C., Stock Number 024-001-02879-4, 1976.

4. Significance and Use

4.1 The alkalinity of natural water is commonly used to obtain a value for the carbonate and bicarbonate concentrations. Carbonate and bicarbonate determinations shall be made in the field at the time of sampling if the concentrations are to accurately reflect those concentrations originally present in the sample.

4.2 The following equations govern the reactions involved:

$CO_3^{2-} + H^+ = HCO_3^-$ (this reaction is complete near pH 8.3),

$HCO_3^- + H^+ = H_2O + CO_2$ (this reaction is complete near pH 4.5).

The end point of pH 8.3 is determined by the color change of the phenolphthalein indicator, and the end point of pH 4.5 is determined by the color change of the bromocresol green-methyl red indicator.

NOTE: If the measured pH of the sample is less than 4.5, there is no carbonate or bicarbonate alkalinity and this test method is not applicable.

5. Interferences

5.1 The measured values may include contributions from borates, phosphates, or silicates if these are present in the sample.

5.2 Natural color or the formation of precipitate while titrating the sample may mask the color change of the indicator, or waste materials may interfere chemically with the color change by destroying the indicator.

5.3 Varying results may be experienced with samples containing oxidizing or reducing substances.

6. Apparatus

6.1 Hach alkalinity test kit Model AL–DT. (This kit contains sulfuric acid, which is a DOT-regulated material; its hazard class is Corrosive Liquid.)

6.2 Distilled or deionized water in a squeeze bottle.

6.3 Kimwipes or equivalent lint-free tissue.

7. Procedure

7.1 Attach a clean, straight-stem delivery tube to a sulfuric acid titration cartridge. If the expected alkalinity is below 100 milligrams per liter (mg/L) as $CaCO_3$, use a 0.16 N H_2SO_4 cartridge; if it is above 100 mg/L as $CaCO_3$, use a 1.6 N H_2SO_4 cartridge; or if it is above 1,000 mg/L, use an 8.0 N H_2SO_4 cartridge. Twist the cartridge onto the titrator body.

7.2 Flush out the delivery tube by turning the small knob until a few drops of titrant are ejected from the tube. Wipe the tip and reset the counter to zero. Ensure that there are no air bubbles in the cartridge.

7.3 Take a sample by filling a clean 100-mL graduated cylinder to the 100-mL mark with water that has been filtered through a 0.45 micrometer (µm) filter. Pour the sample into a clean 250-mL Erlenmeyer flask.

7.4 Measure the pH of the sample; see Standard Test Method for the Field Measurement of pH [LQ–4(T)]. If the pH of the sample is less than 8.3, proceed to step 7.8; if the pH of the sample is greater than 8.3, proceed to step 7.5.

7.5 Add the contents of one phenolphthalein indicator Powder Pillow and swirl to mix.

7.6 If the color turns pink, titrate with the sulfuric acid standard solution to a colorless end point. If the pink color does not develop, proceed with step 7.8.

7.7 Read and record the amount of acid used. This is the amount of carbonate alkalinity, sometimes referred to as phenolphthalein alkalinity. See section 8 for calculations.

7.8 Add the contents of one bromocresol green-methyl red indicator Powder Pillow to the sample and swirl to mix.

7.9 Titrate the sample with the sulfuric acid standard solution until a light pink color is obtained. Read and record the amount of acid used. This is the amount of total alkalinity. See section 8 for calculations.

7.10 Pour the titrated sample into a properly labeled disposal container, rinse the Erlenmeyer flask and the graduated cylinder with distilled or deionized water, and place the items back in the kit.

8. Calculations

8.1 The results are reported in mg/L as $CaCO_3$. The calculation depends on the normality of the sulfuric acid titration cartridge used. The calculations are performed as follows.

8.1.1 When using the 0.16 N H_2SO_4 titration cartridge, the digital readout from the titrator is multiplied by 0.1 to obtain alkalinity results in mg/L as $CaCO_3$.

8.1.2 When using the 1.6 N H_2SO_4 titration cartridge, the results from the digital readout of the titrator are equivalent to mg/L as $CaCO_3$.

8.1.3 When using the 8.0 N H_2SO_4 titration cartridge, the results from the digital readout of the titrator are multiplied by 5.0 to obtain alkalinity in mg/L as $CaCO_3$.

9. Quality Assurance

9.1 The following information about the field measurement of alkalinity shall be logged for quality-assurance documentation.

9.1.1 Normality of the titration cartridge.

9.1.2 Phenolphthalein alkalinity.

9.1.3 Total alkalinity.

9.1.4 Name of person performing the measurement.

10. Precision and Bias

10.1 Under normal conditions, precision and accuracy of ± 15 percent can be expected from this procedure.

11. Keywords

11.1 Alkalinity, bicarbonate, carbonate, and titration.

Standard Test Method for the Field Measurement of Temperature

Introduction

Temperature readings are important for numerous applications. They are used in the measurement of Eh, pH, conductivity, and dissolved oxygen; and in saturation and stability studies. It is important to know the temperature of surface waters and groundwaters for the accurate geochemical evaluation of equilibrium thermodynamics. Temperature readings of ± 1 °C are necessary for the above applications.

1. Scope

1.1 This procedure gives general guidance and recommendations that shall be considered when taking a temperature measurement. There are numerous instruments on the market that can provide adequate temperature measurements. Each instrument-operating manual shall be consulted for detailed procedures.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the planning documents for a particular project.

3. Referenced Documents

3.1 American Public Health Association, *Standard Methods for the Examination of Water and Wastewater*, American Water Works Association, and Water Pollution Control Federation, Washington, D.C., 1980.

3.2 Wood, W.W., "Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents," *Techniques of Water-Resources Investigations of the United States Geological Survey*, Chapter D2, Book 1: U.S. Government Printing Office, Washington, D. C., Stock Number 024–001–02879–4, 1976.

4. Significance and Use

4.1 Temperature is a basic physical property that is measured by the response of matter to heat. There are many devices that, once calibrated, are acceptable for taking temperature measurements. These devices include liquid in glass (mercury in glass), thermocouples, bimetallic, and electrical-resistance thermometers. At a minimum, the device should measure temperature to ± 0.1 °C readability.

5. Interferences

5.1 The instrument-operating manual shall be consulted to identify any interferences particular to the device being used.

5.2 In general, the true sample temperature is affected by the atmospheric temperature of the surroundings and the temperature of the devices used to collect the sample.

6. Apparatus

6.1 Temperature-measuring device.

6.2 Distilled or deionized water in a squeeze wash bottle.

6.3 Kimwipes or equivalent lint-free tissue.

7. Calibration

7.1 The instrument-operating manual shall be consulted for specific calibrating procedures.

8. Procedure

8.1 Rinse the thermometer with distilled or deionized water and blot dry.

8.2 Immerse the thermometer in the sample.

8.3 Allow the reading to stabilize and record the temperature.

9. Quality Assurance

9.1 The following information about the temperature measurement shall be logged for quality-assurance documentation.

9.1.1 Instrument used.

9.1.2 Temperature of sample.

9.1.3 Name of person performing the measurement.

10. Precision and Bias

10.1 Precision is instrument-dependent. Most measurement devices for field use are accurate to ± 0.1 °C.

11. Keywords

11.1 Temperature and thermometer.

Standard Practice for the Sampling of Liquids

Introduction

The type of sampling equipment shall depend on the sample to be collected, which analytes the sample is being collected for, and the site-specific requirements such as depth to water or depth of well. Because each sampling situation is unique, the equipment used and its application may have to be modified to ensure that a representative sample is collected and its physical and chemical integrity is maintained.

1. Scope

1.1 The procedures listed here are used to collect liquid samples. There are eight methods that can be used to collect liquid samples. Some sampling situations use a combination of these methods. For example, a peristaltic pump could be used to collect the inorganic samples and a bailer used to collect the organic samples. The eight methods are

	Section
Method A—Sampling With a Peristaltic Pump	5–7
Method B—Sampling With a Bladder Pump	8–10
Method C—Sampling With a Bailer	11–13
Method D—Sampling With a Submersible Pump	14–16
Method E—Sampling With a Composite Liquid Waste Sampler (Coliwasa)	17–19
Method F—Sampling With a Dip-Type Sampler	20–22
Method G—Sampling by Container Immersion	23–25
Method H—Sampling From Taps, Valves, or Faucets	26–28

2. Hazard Analysis

2.1 These procedures use gasoline-powered electric generators, gasoline-powered air compressors, and battery-powered pumps and accessories. The following safety precautions shall be followed.

2.1.1 Air compressors that are belt driven shall have a belt guard in place.

2.1.2 Care shall be taken when connecting and disconnecting equipment powered by lead-acid batteries to avoid generating sparks that have the potential of creating an explosive hazard.

2.1.3 Gasoline is a Department of Transportation-regulated material; its hazard class is Flammable Liquid. Gasoline shall be stored in Factory Mutual-approved safety cans. Safety cans shall be well secured in the vehicle during transport. Gasoline-powered equipment shall be cool before filling, and care should be taken not to spill any gasoline.

2.1.4 Air compressors shall not be operated above rated capacities and shall be configured to avoid having any dead-end fittings above 20 pounds per square inch (psi).

2.1.5 Care shall be taken when lifting heavy equipment; proper lifting techniques shall be used.

2.1.6 Site-specific controls are available in the planning documents for a particular site.

3. Referenced Documents

3.1 American Society for Testing and Materials, *Standard Guide for Sampling Groundwater Monitoring Wells*, D4448–85a, 1986.

3.2 Geotech, *Environmental Procedures Catalog*, Manual 116:

Standard Practice for Sample Labeling [GN–8(P)].

Standard Practice for Equipment Decontamination [GN–13(P)].

General Considerations for the Sampling of Liquids [LQ–1(G)].

3.3 U.S. Department of Energy, The *Environmental Survey Manual*, Appendix E, Volume 4, DOE/EH–0053, 1987.

3.4 U.S. Environmental Protection Agency, *Handbook of Groundwater*, EPA/625/6–87/016, 1987.

3.5 U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA/600/2–85/104, 1985.

3.6 U.S. Environmental Protection Agency, *SW-846, Test Methods for Evaluating Solid Waste*, Volume 2, 1986.

4. Significance and Use

4.1 The usefulness and limitations for each of the first four sampling methods are listed in General Considerations for the Sampling of Liquids [LQ–1(G)], Table 1 through Table 5. Coliwasa samplers are useful to obtain representative samples of multiphase materials from drums or other containerized vessels. Limitations are their relative high costs and the difficulty of decontaminating the sampler. Dip samplers only collect grab samples with a limited vertical extent. The sampler must be aware of this limitation and also exclude surface debris or films from liquid surfaces if this is not desired. Contamination from plumbing is a primary concern when sampling taps, valves, or faucets.

Method A
Sampling With a Peristaltic Pump

5. Apparatus

5.1 Peristaltic-type pump.

5.2 Silicone, C-FLEX, or Norprene tubing for the pump head.

5.3 Silicone, Teflon, polyethylene, or vinyl tubing for placing in the liquid to be sampled (suction line).

5.4 Generator or other source of electricity.

6. Procedure

6.1 The following procedure supplements the instruction in the instrument-specific operating manual.

6.1.1 Place the suction line in the liquid to be sampled. If sampling a monitoring well, place the tubing inlet just above the screened interval.

6.1.2 Connect the suction line to the pump.

6.1.3 Turn on the pump and adjust the flow rate so sample turbulence is at a minimum. Allow several liters to flow and recheck stability parameters (i.e., pH, conductivity, and temperature).

6.1.4 Fill the necessary sample bottles by allowing the pump discharge to flow gently down the side of the bottle with minimal turbulence.

6.1.5 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

6.1.6 Remove the tubing from the liquid and clean and decontaminate as required by Standard Practice for Decontamination [GN–13(P)].

7. Procedure Bias

7.1 Sampling organics using a peristaltic pump is not recommended. The suction lift action will strip volatiles and degas the sample. The silicone tubing tends to absorb some organics and slowly release them, contaminating subsequent samples.

Method B
Sampling With a Bladder Pump

8. Apparatus

8.1 Bladder-type pump.

8.2 Air compressor.

8.3 Teflon, polyethylene, or vinyl tubing for the air and sample line.

9. Procedure

9.1 The following procedure is supplemental to the instruction in the instrument-specific operating manual.

9.1.1 Lower the pump gently to a position just above the screened interval.

9.1.2 Connect the air line to the pump controller.

9.1.3 Initiate pumping and allow several liters of water to be pumped prior to sample collection (recheck stability parameters, i.e., pH, conductivity, and temperature).

9.1.4 Fill the necessary sample bottles by allowing the pump discharge to flow gently down the side of the bottle with minimal turbulence.

9.1.5 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

9.1.6 Remove the pump from the well and clean and decontaminate as required by Standard Practice for Decontamination [GN–13(P)].

10. Procedure Bias

10.1 Bladder-type pumps constructed of stainless steel, Teflon, or both provide superior performance for most applications. The use of Teflon sample- and air-line tubing allows the bladder pump to be used for the collection of organics. The main disadvantage is the slow pumping rate, large consumption of compressed air, and difficulty in cleaning and decontaminating.

Method C
Sampling With a Bailer

11. Apparatus

11.1 Teflon or stainless steel bailer.

11.2 Teflon or stainless steel cable or line.

11.3 Bailer reel.

12. Procedure

12.1 Attach a properly cleaned bailer to the cable or line.

12.2 Lower the bailer slowly until it contacts the liquid.

12.3 Allow the bailer to sink until it reaches the screened interval of the well or the desired sampling point.

12.4 Slowly raise the bailer to the surface.

12.5 Tip the bailer or use a bottom-emptying device and fill a container to recheck the stability parameters (i.e., pH, conductivity, and temperature).

12.6 Repeat steps 12.2 through 12.5 as many times as necessary to fill the sample bottles.

12.7 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN-8(P)].

12.8 Clean and decontaminate the bailer as required by Standard Practice for Decontamination [GN-13(P)].

13. Procedure Bias

13.1 Bailers constructed of Teflon, stainless steel, or both provide adequate performance for most applications. Bailers expose part of the sample to the atmosphere during sample withdrawal and should not be used to collect samples where contact with the atmosphere is important (i.e., field measurement of dissolved oxygen and Eh). A bottom-emptying device is recommended for the collection of volatile organics using a bailer.

Method D
Sampling With a Submersible Pump

14. Apparatus

14.1 Submersible-type pump.

14.2 Discharge tubing of vinyl, polyethylene, or Teflon.

14.3 Power source of generator or batteries.

15. Procedure

15.1 The following procedure is supplemental to the instructions provided in the instrument-specific operating manual.

15.1.1 Set up the pump according to the operating manual.

15.1.2 Gently lower the pump to a position just above the screened interval.

15.1.3 Initiate pumping and allow several tubing volumes of liquid to be pumped prior to sample collection. Recheck stability parameters, (i.e., pH, conductivity, and temperature).

15.1.4 Fill the necessary sample bottles by allowing the pump discharge to flow gently down the side of the bottle with minimal turbulence.

15.1.5 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN-8(P)].

15.1.6 Remove the pump and clean and decontaminate as required by Standard Practice for Decontamination [GN-13(P)].

16. Procedure Bias

16.1 Considerable sample agitation results when using a submersible pump. Submersible pumps are not recommended for the collection of dissolved gases, organics, or oxidation/reduction-sensitive samples. They also have a higher potential of sample contamination because of the construction material.

Method E
Sampling With a Coliwasa Sampler

17. Apparatus

17.1 Coliwasa-type sampler constructed of stainless steel, Teflon, polyethylene, or glass.

17.2 Teflon, stainless steel, or nylon suspension line.

17.3 Disposable gloves.

17.4 Kimwipes or equivalent lint-free tissue.

18. Procedure

18.1 Slowly lower the sampler into the liquid to be sampled. Lower the sampler at a rate that permits the levels of liquid inside and outside the sample tube to be about the same.

18.2 When the sample interval has been reached, seat the bottom check valve.

18.3 Slowly withdraw the sampler with one hand while wiping the outside of the sampler using a disposable tissue.

18.4 Carefully discharge the sample into the sample container.

18.5 Repeat steps 18.1 through 18.4 as many times as necessary to fill all the sample bottles.

18.6 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

18.7 Clean and decontaminate the sampler as required by Standard Practice for Decontamination [GN–13(P)].

19. Procedure Bias

19.1 The Coliwasa-type sampler is appropriate for collecting samples of containerized liquids. The material of construction should be considered for the particular type of liquid to be sampled. A Coliwasa sampler is also difficult to decontaminate adequately.

Method F
Sampling With a Dip-Type Sampler

20. Apparatus

20.1 Dip-type sampler constructed of Teflon, stainless steel, polyproplylene, or glass.

21. Procedure

21.1 Assemble the sampler.

21.2 Slowly submerge the sampler into the liquid to be sampled causing minimal surface disturbance.

21.3 Retrieve the sampler from the liquid causing minimal surface disturbance.

21.4 Slowly empty the sampler into the sample bottle allowing the sample to flow gently down the side of the bottle.

21.5 Repeat steps 21.2 through 21.4 as many times as necessary to fill all of the sample bottles.

21.6 Label, preserve, and document the samples as required by Standard Practice for Sample Labeling [GN–8(P)].

21.7 Clean and decontaminate the sampler as required by Standard Practice for Decontamination [GN–13(P)].

22. Procedure Bias

22.1 A dip-type sampler is appropriate for surface liquids such as ponds, open tanks, pits, lagoons, and sewers. It can only be used for a grab-type sample, and its material of construction shall be compatible with the liquid to be sampled and the analytes of interest.

Method G
Sampling by Container Immersion

23. Apparatus

23.1 Sample container.

23.2 Disposable gloves.

23.3 Distilled or deionized water in a squeeze bottle.

23.4 Kimwipes or equivalent lint-free tissue.

24. Procedure

24.1 After putting on the appropriate gloves, submerge the sample bottle below the liquid surface. If the liquid is flowing, point the bottle upstream.

24.2 Allow the container to fill to the desired volume.

24.3 Remove the container, cap and rinse the container's outside surface with clean water, and dry with a tissue.

24.4 Label, preserve and document the sample as required by Standard Practice for Sample Labeling [GN–8(P)].

25. Procedure Bias

25.1 The container-immersion method can only be used to collect samples from shallow streams, near the shore of ponds or lakes, or from open-top containerized liquids. It can only be used for a grab-type sample and requires immersing the hands; it is not acceptable for highly polluted or hazardous liquids.

Method H
Sampling From Taps, Valves, or Faucets

26. Apparatus

26.1 Distilled or deionized water in a squeeze bottle.

26.2 Kimwipes or equivalent lint-free tissue.

26.3 If the sample bottle cannot be placed under the tap, valve, or faucet, a hose or other device shall be attached to the outlet to allow the sample to be collected.

27. Procedure

27.1 Turn on the tap, valve, or faucet and allow sufficient liquid to flow to ensure that any rust or residue is removed from the lines and that fresh liquid is flowing.

27.2 Remove the cap from the sample container and place the container under the source.

27.3 Fill the sample bottle to the desired volume.

27.4 Repeat steps 27.2 and 27.3 as many times as necessary to fill all of the sample containers.

27.5 Shut off the tap, valve, or faucet; clean the outside of the sample container using clean water and wipe dry.

27.6 Label, preserve, and document the sample as required by Standard Practice for Sample Labeling [GN–8(P)].

28. Procedure Bias

28.1 This procedure is used to collect grab-type samples from piped systems. Strainers, aerators, and hose attachments should be removed prior to sample collection. The material of construction for the piping system influences sample impurities and should be documented in the field logbook.

29. Quality Assurance

29.1 All of the methods listed above require the following information to be logged for quality-assurance documentation.

29.1.1 Date of sample collection.

29.1.2 Location of sample.

29.1.3 Sample number.

29.1.4 Type of sampling mechanism used.

29.1.5 Container type, size, and number of samples collected.

29.1.6 Preservatives used.

29.1.7 Signature of sampler.

30. Keywords

30.1 Bailer, coliwasa, liquid samples, sampler, and sampling.

Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples

1. Scope

1.1 This procedure addresses the collection, filtration, and preservation of liquid samples. Section 7 gives the general collection procedures. Sections 8 and 9 are specific to the collection of organics. Section 10 provides the procedure for sample filtration. Section 11 provides guidelines for sample preservation. Table 1 summarizes the generally accepted bottle types, volume requirements, preservatives, and holding times for most analytes.

1.1.1 Improper filtration, preservation, or residence time before analysis may compromise sample integrity.

1.2 Many factors should be considered during the sample collection phase: bottle type, bottle size, preservation, sample filtration, and order of sample collection.

2. Hazard Analysis

2.1 This procedure uses a variety of chemicals for preserving the samples. The sampler shall have a copy of and review the Material Safety Data Sheets (MSDS) for each of the chemicals that will be used at a particular site. Most of the preservatives can be categorized as strong acids or strong bases. They are U.S. Department of Transportation-regulated materials.

2.2 The personal protective measures for strong acids (hydrochloric [HCl], nitric [HNO_3], and sulfuric [H_2SO_4]) and strong bases (such as sodium hydroxide [$NaOH$]) are to avoid eye and skin contact and avoid breathing vapors by wearing eye protection and disposable gloves, providing adequate ventilation, and taking first aid measures to flush eyes or skin immediately with water for 15 minutes and contacting a physician.

2.3 Site-specific controls are available in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 Rust Geotech, *Environmental Procedures Catalog*, Manual 116:

GN-8(P), Standard Practice for Sample Labeling.

3.2 U.S. Environmental Protection Agency, *Specifications and Guidance for Contaminant-Free Sample Containers*, Office of Solid Waste and Emergency Response, Washington, D.C., EPA/540/R93/051, NTIS stock number PB93-963316, December 1992.

4. Terminology

4.1 *Meniscus*—The curved, upper surface of a liquid in a container.

4.2 *MSDS*—Material Safety Data Sheet. Printed material that provides descriptions of the properties, hazards, and health and safety considerations of a chemical or material; emergency measures in case of an accident; and instructions on the safe handling of the chemical or material.

4.3 *Organic*—A compound that contains carbon.

4.4 *Volatile*—A compound that readily evaporates at normal temperatures and pressures.

5. Significance and Use

5.1 The procedures listed here are general guidelines. Site-specific requirements vary and no one procedure will fit all situations. In many cases, the judgment of a well-trained, experienced team leader is required to make the necessary decisions in the field to obtain the best sample possible and meet all requirements.

6. Apparatus

6.1 Sample bottles.

6.2 Sample labels.

6.3 Sample ticket books (GJPO 1854), Figure 1.

6.4 Water Sampling Field Data Sheet (GJPO 1805), Figures 2a and 2b.

6.5 Preservative solutions as required by the planning documents.

6.6 Dispensers for preservative solutions.

6.7 Coolers and ice for cooling collected samples.

6.8 In-line filter holders and filter sheets of 0.45 micrometer (µm) pore-size or in-line disposable 0.45-µm pore-size filters.

6.9 Pump and tubing.

Table 1. Guidelines for Preservation of Samples

Analytical Parameter	Container Type/Size[a]	Preservation	Holding Times
Inorganic Anions			
Chloride (Cl), sulfate (SO_4), nitrate (NO_3), fluoride (Fl), bromide (Br), nitrite (NO_2), and orthophosphate	P/500 mL	Filtered 0.45 µm, cool to 4 °C	Cl, SO_4, Fl, Br—28 days NO_2, NO_3, orthophosphate—48 hours
Ammonia	P/125 mL	Filtered 0.45 µm, H_2SO_4 pH <2	28 days
Inorganic Cations			
Dissolved metals	P/500 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Total metals	P/500 mL	HNO_3 pH <2	6 months
Radioisotopes			
Uranium-234/Uranium-238	P/1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Thorium-230	P/1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Polonium-210	P/1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Lead-210	P/1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Radium-226	P/1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Radium-228	P/3 each; 1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Gross alpha/beta	P/1,000 mL	Filtered 0.45 µm, HNO_3 pH <2	6 months
Organics			
Volatile organics	G/2 each; 40 mL	Cool to 4 °C	14 days
Semivolatile organics	G/1,000 mL	Cool to 4 °C	7 days extraction, 40 days analysis
Polychlorinated biphenyls and pesticides	G/1,000 mL	Cool to 4 °C	7 days extraction, 40 days analysis
Herbicides	G/1,000 mL	Cool to 4 °C	7 days extraction, 40 days analysis
Total organic halides (TOX)	G/1,000 mL	Cool to 4 °C	28 days
Total organic carbon (TOC)	G/125 mL	H_2SO_4 pH <2, cool to 4 °C	28 days
Phenols	G/1,000 mL	H_2SO_4 pH <2, cool to 4 °C	28 days
Oil and grease	G/1,000 mL	H_2SO_4 pH <2, cool to 4 °C	28 days
Other			
Biochemical oxygen demand (BOD) and chemical oxygen demand (COD)	G/1,000 mL	Cool to 4 °C	BOD—48 hours COD—28 days
Total dissolved solids	P/250 mL	Cool to 4 °C	7 days
Cyanide	P/1,000 mL	NaOH pH >12, cool to 4 °C	14 days
Sulfide	P/1,000 mL	2 mL zinc acetate, NaOH pH >9, cool to 4 °C	7 days

[a]P = polyethylene; G = glass; mL = milliliter.

NBB 651

Project GJ-12345

Site NA Location 323145

Date 1-28-94 Time 11:02 am Matrix Soil

Interval 0-6" Sampler CRK

Comments Next to underground storage tank fill spout.

Analyte(s)	Container Type	Number Collected	Filtered	Preservative
VOC	500 ml WM	1	NA	NA
Metals	1000 ml WM	1	NA	NA
		CRK		

White copy to Project Manager, canary to laboratory, pink remains in ticket book

Figure 1. Example of a Sample Ticket, GJPO 1854

6.10 Distilled water and Kimwipes or other lint-free tissue.

6.11 Project logbook.

7. General Sample Collection Procedures

7.1 Collect all samples as close to the source as possible.

7.2 Choose the appropriate bottles for the analytes needed (see Table 1). Visually inspect the bottles for cleanliness, breaks, and missing parts prior to sampling. Sample bottles should be pre-cleaned to guidelines established by the U.S. Environmental Protection Agency (EPA) in reference 3.2.

7.3 Complete the sample ticket (Figure 1) and label the bottles as required by the planning documents or Standard Practice for Sample Labeling [GN-8(P)], reference 3.1.

7.4 Preservatives may be added at this time, or they may be added after sample collection.

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303/248-6000

Water Sampling Field Data

1. Date 2-3-95 Project Location Monticello Sampling Site 82-30B
Sample No. NB0052

2. Measure well-water depth and calculate volume.
Depth to water 10.12' Depth of well 30.0' Well diameter 2"
Depth of water 19.88' Calculated casing volume 3.2 gal Borehole diameter 8"
Calculated borehole volume 10.6 gal Length of filter pack 10'

3. Sampling device QED deidicated bladder pump

4. Measurement equipment HACH model 2100 P turbidimeter, YSI model 50B dissolved oxygen meter, YSI model 3500 water quality indicator

5. Measure sample temperature: 10.1 °C Time 0935 Instrument used YSI 3500

6. Measure conductivity: Time 0935 Sample Conductivity 2850 μmhos/cm
Sample specific conductance at 25 °C 3984 μmhos/cm
Measurement conditions: In situ ( ) Open container ( ) Air exclusion (X)
Time of last calibration check 0900
Temperature of calibration standard 9.3 °C
Conductivity reading of calibration standard 700 μmhos/cm, at 25 °C 1000 μmhos/cm

7. Measure pH: Time 0935 Sample pH 6.98
Measurement conditions: In situ ( ) Open container (X) Air exclusion ( )
Time of last two-buffer calibration 0900
Buffer temperature at calibration 9.3 °C Buffers used 4, 7

8. Measure turbidity: Time 0935 Sample Turbidity 3.32 Time of operational check 0900
Assigned values to Gelex standards 4.39 560 512 Reading of Gelex standards 4.93 55.8 514

9. Measure Eh: Time 0935 Sample Eh 37 mV
Measurement conditions: In situ ( ) Open container ( ) Air exclusion (X)
Temperature of ZoBell solution 9.3 °C
Eh of ZoBell solution 247 mV

10. Measure dissolved oxygen (DO): Time 0940 Sample DO 1.25 mg/l
Date and time of last zero check with $NaSO_3$ solution 2-3-95 0910
Atmospheric pressure NA mmHg Altitude 7000 ft
Temperature of calibration chamber 11.0 °C
DO saturation from table 11.1
Correction factor 0.77 Calibration value 8.55

11. Measure alkalinity: Time 0943 Total alkalinity 310 ppm as $CaCO_3$
Hach Kit method: Titration cartridge 1.6 N H_2SO_4
Phenolphthalein alkalinity NA

12. Number and type of filters used 1 .45μ QED

GJPO 1805
1/95

Figure 2a. Example of a Water Sampling Field Data Sheet GJPO 1805 (front)

Sampling Site 82-30B Sample No. NSD052

Purge Data

13.

Date	Time	Total Volume Withdrawn (gal)	Total Volume Withdrawn (casing / bore vol)	pH	Ec (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Eh (mV)	DO (mg/L or %)	Comments
2-3	0915	0.0	0.0	—	—	—	—	—	—	Start Pumping
	0920	.75	.2	6.92	2840	10.0	10.4	39		
	0925	1.5	.5	6.97	2860	10.1	7.36	38		recalibrated pH meter
	0930	2.25	.7	6.98	2850	10.1	5.12	38		
	0935	3	.9	6.98	2850	10.1	3.82	37		
2-3	0940	3.5	1.1	—	—	—	—	—	1.25	

SC
2-3-95

14. Comments

Signature of Sampler Sam Campbell Date Signed 2-3-95

Checked by Wendee Ryan Date Checked 2-3-95

Figure 2b. Example of a Water Sampling Field Data Sheet GJPO 1805 (back)

(Samples collected without headspace must be pre-preserved.)

7.5 Collect the samples by allowing the liquid to flow gently down the side of the bottle with minimal turbulence. Collect unfiltered samples prior to filtered samples.

7.6 Collect unfiltered samples in the following order:

7.6.1 Volatile organics and total organic halides.

7.6.2 Dissolved gases and total organic carbon.

7.6.3 Large-volume samples for organic compounds.

7.6.4 Sensitive inorganics, such as nitrogren dioxide, ammonium, and ferrous oxide.

7.6.5 Total metals.

7.7 Collect filtered samples in the following order:

7.7.1 Alkalines.

7.7.2 Sensitive inorganics.

7.7.3 Trace metals.

7.7.4 Major cations/anions.

7.7.5 Radionuclides.

7.8 Add preservative as required, if not pre-preserved.

7.9 Cap the bottle securely.

7.10 Store as required. Some samples may require storing at 4 °C immediately after collection. Use a cooler with ice for storing these samples.

7.11 Complete the Water Sampling Field Data Sheet (Figures 2a and 2b) as shown.

8. Nonvolatile Organics Sampling Procedure

8.1 Follow steps 7.1 through 7.3.

8.2 Add preservatives to the bottle, if required.

8.3 Collect samples for nonvolatile organics by slowly filling the bottle, allowing the liquid to flow gently down the side of the bottle with minimal turbulence. Do not filter samples to be analyzed for organics.

8.4 Cap the bottle securely.

8.5 Store as required. Most organic samples require storage at 4 °C.

9. Volatile Organics Sampling Procedure

9.1 Take special care when collecting a volatile organic sample to reduce the possibility of losing the volatile constituents. Volatile organics are collected in a 40-milliliter (mL) glass vial that has a Teflon-lined, silicone-septum cap.

9.2 Label the vial.

9.3 Add preservative (if required).

9.4 Slowly fill the vial to overflowing.

9.5 Hold the vial level or carefully set it on a level surface.

9.6 Place the cap with septum, Teflon-side down, on the convex water meniscus and seal by screwing the cap to the bottle.

9.7 Check for air bubbles by inverting the vial and lightly tapping. There can be no air bubbles entrapped in the sample. If bubbles are present, uncap the vial, empty the contents, and repeat steps 9.3 through 9.7.

10. Sample Filtration Procedure

10.1 Collect samples requiring filtration after unfiltered samples. If a pump is used, connect an in-line membrane filter directly to the pump outlet to filter the sample. If a bailer is used, connect the filter to the portable pump and pump the sample from the bailer or a clean sample bottle.

10.2 Start the pump and discard the first 100 mL of sample to flush the filter.

10.3 Place the sample bottle directly under the filter outlet and fill to the desired volume.

10.4 Preserve the sample (if not pre-preserved), as required.

10.5 Stop the pump, and disconnect the filter.

10.6 Discard the used filter after each sample. If a filter holder is used, clean all surfaces of the filter holder with distilled water and wipe dry with a lint-free tissue.

10.7 If a filter holder is used, place a new filter in the holder and reassemble.

11. Sample Preservation Guidelines

11.1 Samples are preserved by a variety of means to stabilize specific parameters so that the samples can be shipped to a laboratory for analysis. Preservatives are intended to (1) retard biological effects, (2) retard hydrolysis, (3) reduce sorption effects, and (4) reduce volatility of constituents.

11.2 Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light. The following guidelines shall be considered during sample preservation.

11.2.1 Preservation of samples uses a variety of strong acids and bases. Care shall be taken in their storage and use; see section 2.

11.2.2 Preserve samples prior to or as soon after collection as possible.

11.2.3 Take care not to cross-contaminate samples with preservatives.

11.2.4 Place samples requiring cooling to 4 °C in an ice chest with ice immediately after collection.

11.2.5 Consult Table 1 or the planning documents for recommended sample preservation techniques for each parameter. Generally, the laboratory performing the analysis will determine the bottle type, volume, and preservative to be used for a particular sampling event.

12. Quality Assurance

12.1 In the sample ticket book (Figure 1) or Water Sampling Field Data Sheet (Figures 2a and 2b), record the following information about the sample collection, filtration, and preservation for quality-assurance documentation.

12.1.1 The number and type of filter used for filtration.

12.1.2 The bottle size, bottle type, and number of samples collected.

12.1.3 The type of sample filtration, if any.

12.1.4 The preservative used.

12.1.5 The name of the person performing the sampling.

13. Keywords

13.1 Bottles, collection, filtration, liquid samples, organics, and preservation.

Environmental Procedures Catalog

Document Addition/Revision

Procedure Title Standard Practice for the Inspection and Maintenance of Groundwater Monitoring Wells [LQ-18(P)], Rev. 1, 6/92

Requester Sam Campbell

Justification The Well Maintenance Checklist form has been revised to allow multiple inspections and water-level measurements to be recorded on one form. An electronic data entry device has been purchased for project use. Subsurface inspection of inactive wells is not required because redevelopment of an idle well is not appropriate. If a well is changed from inactive to active status, the total depth will be measured and the redevelopment criteria will apply.

Proposed Changes (list here or attach copies) Section 5.1 & 6.2.1-The Well Maintenance Checklist is replaced by the Monticello Well Maintenance Data Sheet (attached). Section 6.2.1-Insp. information will be entered into an electronic hand-held data entry device. The Well Maint. Data Sheet will be used as a back-up method for data entry. Section 6.2.3-Total depths will be measured only on active wells (wells that are sampled or have water level measured); wells with dedicated pump installations will not have total depth measured.

New Document

Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned ______

______ *Manager, Compliance Management* ______ *Date*

Project-Specific Change for Operable Unit III Annual Monitoring Program
Project

Reviewed by Mark Kautz 2-25-97
Technical Author or Senior Proficient Designee *(date)*

Approved by [signature] 2/25/97
Manager or Designee *(date)*

Effective Date 4/1/97

MONTICELLO WELL MAINTENANCE DATA SHEET

Well Identification ______________ **N.** ____________ **E.** ____________

Measuring Point ________________ **Measuring Point Elevation** ______________

Reported Depth _________________ **Dedicated Pump Installed** ______________

	Subsurface Inspection			Surface Components Inspection							
Date	Measuring Device	Depth to Water (ft.)	Total Depth (ft.)	Well Label	Guard-posts	Lock	Protective Casing	Pad	Riser Cap	Technician Initials	Comments

Surface Components Inspection: S - Satisfactory
D - Deficient

Rev. 2/97

Standard Practice for the Inspection and Maintenance of Groundwater Monitoring Wells

Introduction

Groundwater monitoring wells are commonly used for obtaining groundwater samples, groundwater elevation measurements, and aquifer hydraulic parameters. Because of natural processes and human activities, the condition of groundwater monitoring wells may deteriorate with time. If the deterioration of a particular monitoring well is not documented and corrected, decisions based upon data collected from that well may be adversely affected. This procedure provides a standard practice for maintaining a record of the condition of a well and remediating wells that have deteriorated.

1. Scope

1.1 This procedure describes the standard practice for conducting routine inspections of groundwater monitoring wells. The procedure also provides criteria to use in determining if and when a monitoring well should receive corrective maintenance. Corrective maintenance activities are based on the results of the routine inspections. Lastly, this procedure describes the standard practices for conducting well maintenance. Well maintenance includes correcting deficiencies in the surface components of the well and redeveloping the well.

1.2 This procedure shall be applied only to groundwater monitoring wells. Groundwater production wells, used for water supply, are beyond the scope of this procedure. Because of the limitations associated with the redevelopment methods described in this procedure, the redevelopment section is not applicable to wells exceeding 6 inches in diameter. This procedure shall not be applied to multi-port, single-string monitoring wells.

1.3 This procedure shall be executed by a designated well-maintenance technician on all monitoring wells under the control of Geotech. At the discretion of the Project Manager and appropriate regulatory agencies, inactive monitoring wells may be excluded from redevelopment activities. This procedure should be performed quarterly, unless the Project Manager specifies a different frequency. At the discretion of the Project Manager, the procedure may be implemented in conjunction with routine groundwater sampling and data collection activities. In such a case, the inspection portion of the procedure shall be conducted prior to groundwater sampling and other data collection activities. All well-maintenance activities shall be conducted after groundwater sampling activities to eliminate the potential for contaminating samples or altering the chemistry of groundwater samples.

2. Hazard Analysis

2.1 This procedure may involve the use of methanol for decontaminating water-level measurement devices and well redevelopment equipment. Methanol is a Department of Transportation (DOT)-regulated material; the DOT hazard class is Flammable Liquid. Methanol is also an Occupational Safety and Health Administration (OSHA)-listed toxic and hazardous substance. Avoid eye and skin contact by wearing indirectly vented chemical goggles and disposable nitrile gloves. Avoid breathing vapors. Use only in well-ventilated areas. Keep away from heat, sparks, and flames.

2.2 Monitoring wells that penetrate contaminated subsurface environments may contain toxic or hazardous vapors at pressures exceeding atmospheric pressure. These vapors can be expelled from the well bore when the riser cap is removed. If a well penetrates highly contaminated subsurface materials or groundwater, the off-gassing of vapors could continue for an extended period of time. If previous air-monitoring data have shown that the concentration of organic vapors exceeds the action level specified in the project Health and Safety Plan, respirators with combination organic/particulate cartridges shall be worn prior to the opening of the well. The respirators shall continue to be worn throughout the rest of the procedure or until current air-monitoring data indicate organic vapor concentrations have dropped below the action level. For all other wells, stand upwind of the well when removing the riser cap and performing inspection and maintenance activities. Allow the well riser to ventilate for 5 minutes after opening before initiating inspection and maintenance activities. If the degree of contamination at the well site is unknown, or if the well has never been monitored for vapors by Geotech personnel, the air in the well bore shall be checked for the presence of volatile organic vapors prior to continuing with the procedure. Use a calibrated organic vapor analyzer (OVA) or photoionization detector (PID) to measure the total concentration of organic vapors. If the concentration indicated on the OVA (or PID) exceeds the action level specified in the project Health and Safety Plan, allow off-gassing to continue until the OVA (or PID) indicates that the concentration has dropped below the action level. If the concentration continues to exceed the action level, respirators with combination organic/particulate cartridges shall be worn during the inspection and maintenance procedure.

2.3 This procedure may involve the use of compressed nitrogen gas for redeveloping monitoring wells. Compressed nitrogen is supplied in steel tanks and injected into the well through a regulator, a flexible hose, and a series of threaded polyvinyl chloride (PVC) pipes. Improper use of equipment or failure of equipment could cause an explosive rupture of the redevelopment apparatus. Safety glasses, a hard hat, and steel-toed safety shoes shall be worn at all times when using a compressed nitrogen apparatus for the redevelopment of monitoring wells. Because the valve on a compressed nitrogen bottle is susceptible to breakage, the valve cover shall be screwed tightly in place during transport in vehicles, transport on hand trucks, or manual transport by well maintenance personnel. Additionally, the line pressure set on the regulator shall not be set in excess of 50 percent of the minimum-rated bursting pressure of either the flexible hose or the PVC pipe.

3. Referenced Document

3.1 Geotech, *Environmental Procedures Catalog* (Manual 116):

Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells [LQ-2(T)].

4. Significance and Use

4.1 *Significance* —Application of this practice will prevent most forms of degradation in monitoring wells. Application of this procedure will prevent the undetected contamination of monitoring wells by infiltrating surface water and ensure a long service life for monitoring well installations.

4.2 *Use* —This procedure shall be used to (1) maintain an ongoing permanent record that documents the condition of groundwater monitoring wells, (2) identify when monitoring wells require maintenance, and (3) specify the procedures that shall be used to conduct monitoring-well maintenance. The procedure shall be implemented on a quarterly basis by a well-maintenance technician. Each time the inspection portion of the procedure is executed, the Well Maintenance Checklist (Figure 1) shall be completed and filed in the Project Well Maintenance File by the well-maintenance technician. At the discretion of the Project Manager, the procedure may be implemented more or less frequently, and the procedure may be executed by a groundwater sampling team. If the procedure is executed by a sampling team, the inspection portion of the procedure shall be performed prior to sampling a well. Any required maintenance activities shall be performed after sampling a well. This procedure shall not be applied to water-supply wells. Application of this procedure shall be limited to monitoring wells 6 inches in diameter or less.

5. Apparatus

5.1 Well Maintenance Checklist (Figure 1).

5.2 Electric water-level sounder.

5.3 Interface probe (optional).

5.4 Calibrated organic vapor analyzer or photoionization detector (optional).

5.5 Safety glasses.

5.6 Indirectly vented chemical goggles.

5.7 Nitrile gloves.

5.8 Respirator with combination organic/particulate cartridges.

5.9 Steel-toed safety shoes.

5.10 Hard hat (optional).

5.11 Laboratory-grade methanol in a squeeze wash bottle or pump spray canister.

5.12 Alconox or equivalent.

5.13 Distilled or deionized water in a squeeze wash bottle or pump spray canister.

5.14 Kimwipe or equivalent lint-free tissue.

Well Maintenance Checklist

Site Identification ______________________ Well Number ______________________

Date ______________________ Field Technician ______________________

Surface Components Inspection	(circle one)		Action Required/Taken
Lock Working	Yes	No	______________________
Cap on Surface Casing Present	Yes	No	______________________
Surface Casing Intact	Yes	No	______________________
Riser Cap Present	Yes	No	______________________
Guard Posts Adequately Painted for High Visibility	Yes	No	______________________
Concrete Surface Pad Present	Yes	No	Intact Yes No ____________
Well Clearly and Correctly Numbered	Yes	No	______________________
Organic Vapor Monitoring Conducted	Yes	No	______________________

Subsurface Inspection

	Upper or Single Completion	Middle Completion	Lower Completion
Reported Depth of Well (below top of casing)	________	________	________
Reported Bottom of Screened Interval (below top of casing)	________	________	________
Static Depth to LNAPL (below top of casing)	________	________	________
Static Depth to Water (below top of casing)	________	________	________
Static Depth to DNAPL (below top of casing)	________	________	________

Redevelop if measured well depth is less than or equal to depth of bottom of screened interval.

Redevelopment Conducted Yes No Method Used ______________________

Comments/Recommendations ______________________

____

____

Completed by ______________________ Verified by ______________________

Figure 1. Well Maintenance Checklist

5.15 Measuring tape with engineering scale (required if graduations on water-level sounder or interface probe are greater than 0.01 foot).

5.16 Compressed-nitrogen tank (required when using compressed nitrogen).

5.17 Compressed-gas regulator (required when using compressed nitrogen).

5.18 Nitrogen-jetting well-head apparatus (required when using compressed nitrogen).

5.19 Flexible compressed-gas transmission hose (required when using compressed nitrogen).

5.20 Threaded PVC pipe (required when using compressed nitrogen).

5.21 Jetting-T (required when using compressed nitrogen).

5.22 Submersible pump (optional).

5.23 Suction-lift pump (optional).

5.24 Surge block (optional).

5.25 PVC hose (optional).

5.26 Foot valve (optional).

5.27 High-visibility spray paint.

5.28 Steel stamp (for numbering wells).

5.29 Black permanent marking pen.

5.30 Black ink pen.

5.31 Well-location map.

6. Procedures

6.1 This procedure is composed of three sections: Section 6.2, Inspection and Documentation; Section 6.3, Maintenance Criteria and Corrective Action; and 6.4, Redevelopment Procedures.

6.2 *Inspection and Documentation*

6.2.1 Each item on the Well Maintenance Checklist shall be completed as the inspection is conducted. Corrective action to eliminate deficient aspects of a well installation is described in section 6.3. For multi-completion monitoring wells (multiple-well casings in a single borehole), a single Well Maintenance Checklist shall be completed for a group of completions in a common borehole.

6.2.2 *Surface Components Inspection* —The first step of the inspection is to inspect the above-ground components of a monitoring-well installation. Some surface components identified in this section of the procedure are optional and will not be required at each well installation. An example is guard posts. The Project Manager and well-maintenance technician shall determine which components are required.

6.2.1.1 Check for presence of a lid on the steel security casing. If damaged, describe damage in "Comments/Recommendations" section of the Well Maintenance Checklist.

6.2.1.2 Check the lock on the steel security casing for proper operation.

6.2.1.3 Inspect the steel security casing for damage. If a drain or vent hole is present in the security casing, check to ensure that it is not plugged with debris. Clean the hole if necessary.

6.2.1.4 Check for presence of a casing-riser cap. If the well is a flush-mount well, note whether the casing-riser cap is a water-tight cap, slip-on cap, or a threaded cap.

6.2.1.5 Inspect the casing riser for damage. No contamination should be able to enter the well through openings in the side of the casing riser. Note that some casing risers have a "weep" hole drilled just below the riser cap. This hole allows air pressure in the well to equilibrate with atmospheric pressure as water levels or the atmospheric pressure fluctuates. This weep hole should not be closed. If the well is a flush-mount installation and the riser has a weep hole, note this fact in the "Comments/Recommendations" section of the Well Maintenance Checklist. Weep holes are generally not recommended for flush-mount wells as they permit liquids to enter the well if the flush-mount vault becomes flooded. Weep holes in the risers of flush-mount wells are permissible if the vault of the flush-mount installation has been installed to permit drainage from the vault or the vault has a water-tight cover.

6.2.1.6 Check for the presence of guard posts. If present, note whether guard posts are adequately painted for high visibility. If guard posts are not present, note this on the Well Maintenance Checklist.

6.2.1.7 Check for the presence of a concrete surface pad surrounding the security casing. If the concrete surface pad is absent or damaged, note this information on the Well Maintenance Checklist.

6.2.1.8 Check the well number or well identification to determine if it is clearly marked and in agreement with the well location map.

6.2.2 *Subsurface Inspection* —The second step of the inspection is to determine the subsurface condition of the well. This includes measuring the depth to water and the depth to the bottom of the well. The measured depth to the bottom of the well, when compared to the recorded well depth and screened interval depth, will indicate the amount of sediment in the well. If sediment has accumulated to a level above the bottom of the screened interval, the well should be redeveloped. If a well is located near storage tanks or transmission lines that contain fuels, solvents, or other immiscible organic liquids, liquid levels in wells should be measured with an interface probe that is capable of detecting light non-aqueous-phase liquids (LNAPLs or floaters), water, and dense non-aqueous-phase liquids (DNAPLs or sinkers). The procedure for measuring liquid levels in wells is described in Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells [LQ–2(T)]. Nitrile gloves should be worn when conducting the subsurface inspection on wells with organic contaminants in the groundwater.

6.2.2.1 Record the reported depth of the well on the checklist (this can be done prior to departing for a field site). The depth should be recorded to the nearest 0.01 foot below the top of the casing.

6.2.2.2 Record the reported depth to the bottom of the screened interval (this can be done prior to departing for a field site). The depth should be recorded to the nearest 0.01 foot below the top of the casing.

6.2.2.3 If previous air-monitoring data have shown organic vapor concentrations that exceed action levels specified in the project Health and Safety Plan, respirators with combination organic/particulate cartridges shall be worn during the procedure. If the well head has never been monitored for organic vapors, or if there are other reasons to suspect severe organic chemical contamination in the subsurface near the well, the off-gases escaping from the well head should be monitored with an OVA or PID prior to making measurements. In such a case, the OVA or PID shall be calibrated each day prior to use. The casing-riser cap shall be removed and the well allowed to ventilate for 5 minutes. If the well is a flush-mount installation, all water standing in the vault shall be bailed prior to removing the riser cap. Place the intake nozzle of the OVA or PID just inside the well bore. Note the reading on the checklist. If the reading exceeds the action level specified in the project Health and Safety Plan, allow the well head to continue off-gassing for several minutes and then repeat the OVA or PID measurement. Record the reading on the checklist. Once the OVA or PID indicates the concentration is less than the action level, proceed with the inspection procedure. If the organic vapor concentration does not drop below the action level, respirators with combination organic/particulate cartridges shall be worn for the remainder of work performed at the well. If the air contained in the well bore is known to contain no toxic vapors, no OVA or PID measurement is required.

6.2.2.4 Clean the water-level sounder or interface probe prior to inserting in the well, following the procedure presented in Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells [LQ–2(T)].

6.2.2.5 Measure the depth to water to the nearest 0.01 foot and record on the checklist. The depth shall be measured from the top of the casing riser; see Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells [LQ–2(T)]. If the well has contained NAPLs in the past, if it is located near NAPL storage or transmission equipment, or if the OVA or PID reading was unusually high, an interface probe should be used to measure an LNAPL-air interface depth, an LNAPL-water interface depth, and a water-DNAPL interface depth. On the Well Maintenance Checklist record the depth to the air-LNAPL interface after "Static Depth to LNAPL," record the depth to the LNAPL-water interface after "Static Depth to Water," and record the depth to the water-DNAPL interface after "Static Depth to DNAPL."

6.2.2.6 Measure the total depth of the well by gently lowering the probe to the bottom of the well. After the probe reaches the well bottom, slowly raise and lower it several times to accurately determine the depth to the top of any sediment column that may have accumulated in the well. Record the depth to the nearest 0.01 foot on the Well Maintenance Checklist.

6.2.2.7 Use lint-free tissue, methanol (if organic contaminants are known or suspected to be present in the groundwater), and distilled or deionized water to clean the cable as it is removed from the well. The cable should first be cleaned with methanol (if necessary), followed by deionized or distilled water. When the probe is removed from the well, rinse it first with methanol (if necessary), then deionized or distilled water. Wipe the probe dry with a lint-free tissue. If non-aqueous-phase liquids are present in a well, the cable and probe should be cleaned with Alconox (or equivalent) prior to cleaning with methanol and deionized water. During decontamination, care should be taken to prevent methanol or wash water from dripping into the well.

6.3 *Maintenance Criteria and Corrective Action*

6.3.1 This section describes criteria used to evaluate the conformance or nonconformance aspects of each component of the well inspection. For each nonconformance criteria, a corrective action is described. Whenever possible, corrective action should be implemented during the same field trip during which a nonconformance aspect was identified. Any corrective action taken should be noted on the Well Maintenance Checklist.

6.3.2 If the lid on the security casing is missing or damaged to the point of permitting access to the well, arrange a temporary cover, if possible, and make arrangements to have a new lid fixed to the security casing (commonly by welding).

6.3.3 If the lock on the steel security casing is missing, it should be replaced. If all monitoring-well locks currently in use at a site are keyed identically, a similarly keyed lock should be used to replace a missing one. However, if a lock of the same key type as other security casing locks is not immediately available, any strong lock should be installed for temporary well protection. In such a case, note the need for a new lock on the checklist. If a lock has become difficult to operate because of exposure, two or three drops of lubricant should be added to the tumbler assembly. **Do not** over-lubricate or use sprays as these actions will give rise to contamination of the well or sampling equipment that will be used at the well in the future. Note all corrective action on the checklist.

6.3.4 If the entire steel security casing is missing, make arrangements to replace it. The bottom of the security casing should be set 3 feet below the ground surface in concrete. The concrete should extend to the surface and be sloped away from the well. Repairs should be made if the security casing is in place but is damaged and allows liquids to drain into the annular space around the well casing or is preventing proper access to the well. If repairs cannot be made, the need for these should be noted on the checklist.

6.3.5 If the casing-riser cap is missing, replace it. If the well is not a flush-mount well and the casing riser does not have a small drilled hole just below the cap, the riser cap should **not** be installed in an air-tight manner. If the well is a flush-mount well, the riser cap should be a water-tight cap. The water-tight cap should be installed securely in the well to prevent liquids that collect in the vault from entering the well casing. Flush-mount wells with vaults that permit drainage from the vault or those with water-tight vault lids do not need water-tight riser caps.

6.3.6 If the casing riser is damaged to the extent that standing liquids inside the security casing can enter the well, the damaged section should be cut off below the point of breakage. A new section of casing riser should then be tapped to accept a tapered stainless-steel male/male threaded pipe coupling. The top of the cut casing is then also tapped, and the coupling is wrapped with Teflon pipe tape. The coupling is then screwed into the new riser extension, and this assembly is screwed into the top of the cut casing riser. The new riser should have a weep hole drilled in it just below the cap to allow air pressure equilibration within the well bore. Care should be taken to ensure that the new casing riser is fitted with a casing-riser cap. This corrective action should be noted on the checklist and the well should be scheduled for a new elevation survey.

6.3.7 If the well is not a flush-mount installation and is in a location subject to equipment or vehicle traffic, guard posts should be present. If guard posts are not present but are needed, make arrangements for installation as soon as possible. To be effective, three guard posts should be installed in the shape of an equilateral triangle centered at the well with each post 2 to 3 feet from the well. The guard posts should be painted with a highly visible paint, such as Day-Glo orange or safety yellow. Approval of the manager of the site should be obtained prior to installing and painting guard posts.

6.3.8 If the concrete surface pad is damaged or is missing, a new concrete surface pad should be installed or arrangements should be made for the installation of a concrete surface pad. The pad should extend 1 foot below the ground surface and 3 feet horizontally from the security casing. The pad should be sloped away from the well.

6.3.9 If the well is not numbered or marked with a well identification label, or if the number on the well does not match the well location map, a correct well identification number must be marked on the well. First, the correct well identification must be conclusively determined. This can be done by (1) consulting the well location map, if it has been certified to be correct; (2) consulting original field logs and completion records relating to the well's installation; and (3) consulting logs from other previous field activities such as sampling, episodes, and water-level measurements. Project personnel may also be interviewed in an effort to establish well identification. Once the identity of the well has been conclusively established, the well should be labeled with this number using a permanent method. Stamping the well identifier into the steel security casing with a steel stamp is recommended. The identifier should be stamped in the lid on the security casing and on the security casing itself, just below the lock. The identifier should also be written on the bottom-side of the security casing lid using a permanent ink pen. Multiple-completion wells should have the top of each riser cap marked with a letter designating the completion, such as "U" and "L" for "upper" and "lower," respectively. The casing risers in a multiple-completion well should then be marked in a similar manner. Take care to ensure that the label on the casing riser is below the position occupied by the cap or the weep hole, if present.

6.4 *Redevelopment Procedures*

6.4.1 Monitoring wells shall be redeveloped if the well-inspection procedure indicates that excessive sedimentation is occurring, if the capacity of the well appears to have significantly declined during the course of a sampling program, if there is evidence of screen encrustation or clogging by iron bacteria, or if the well is simply scheduled for regular redevelopment.

6.4.2 Possible redevelopment techniques include (1) compressed-nitrogen-jetting and air-lift pumping, (2) surge-blocking and pumping or bailing, (3) suction-lift pumping, (4) submersible pumping, and (5) foot-valve pumping.

6.4.3 Successful redevelopment requires that water be forced from the casing into the formation, and from the formation into the casing. This is best accomplished through the use of a surge block. Compressed-nitrogen jetting can also accomplish this flow reversal to some extent. Techniques 3, 4, and 5 (above) are not effective in achieving flow reversal and are, therefore, best used in conjunction with nitrogen jetting or surge blocking.

6.4.4 Prior to placing any redevelopment equipment in a monitoring well, the equipment shall be cleaned by washing with soapy water (Alconox or equivalent), rinsing with methanol followed by deionized water, and wiping dry with a lint-free tissue. After removing redevelopment equipment from a well, the equipment shall be cleaned again. Methanol should only be used for cleaning after redevelopment if organic contamination is suspected or known to be present in the well. Alconox should only be used if the well is suspected or known to contain non-aqueous-phase liquids (fuels and/ or solvents).

6.4.5 *Nitrogen-Jetting Redevelopment Procedure*

6.4.5.1 If site conditions require that purge water from the well be contained, a discharge-control apparatus should be installed on the well riser. This apparatus typically consists of a compression-sleeve coupling with a discharge port that is connected to the well riser. A compression-type seal for the jetting pipe is rigged at the top of the discharge-control apparatus. Even if site regulations do not require discharge water to be collected and stored, a discharge-control apparatus should be used at sites that may have contaminated groundwater. Use of the discharge-control apparatus will prevent the splashing of discharge water on well-maintenance technicians.

6.4.5.2 A jetting-T is connected to a series of PVC pipes (the jetting pipe) and lowered to the top of the screened interval. The top of the jetting pipe is then connected to a compressed nitrogen source via a flexible compressed gas transmission hose. The flexible hose is connected to a two-stage regulator on the nitrogen source. The first stage of the regulator displays the pressure in the nitrogen tank. The second stage displays the pressure at the flexible hose when the regulator is opened. To prevent injury caused by the nitrogen tank falling over, the tank must be either secured in an upright position with a chain or placed on its side and secured by wheel chocks.

6.4.5.3 Set the line pressure on the regulator at a maximum of 60 pounds per square inch (psi). Jet the well screen by quickly opening the line valve, allowing the water to rise in the well, and then closing the line valve. As air (or nitrogen) escapes from the water column, the water in the well will fall back to near static levels and give rise to a flow reversal from the well into the formation. This pulsed jetting should be repeated for the entire length of screened interval by lowering the jetting pipe in small increments. The pulsed jetting will loosen sediment from the screen, the filter pack, and the well bottom.

6.4.5.4 As material is loosened during the pulsed jetting, the well should be air-lift pumped to remove the dislodged sediment. Air-lift pumping is accomplished by slowly but steadily opening the line valve. This will discharge nitrogen into the water column within the well. The water will rise in the well as the nitrogen is introduced and expands. If the water level reaches the top of the well before the injected nitrogen reaches the top of the water column, "successful" air-lift pumping will occur. Air-lift pumping can continue as long as water is entering the well at a fast enough rate to maintain an aerated water column that extends to the top of the well.

6.4.5.5 Repeat the combination of pulsed jetting over the length of the well screen and air-lift pumping at least once. If the capacity of the well is not returned to near-original levels, or if the clarity of the well water fails to improve after the second cycle, the nitrogen-jetting redevelopment process shall be continued until the capacity of the well and the clarity of the water cease to improve.

6.4.6 *Surge-Blocking Redevelopment Procedure*

6.4.6.1 Lower the surge block into the well to a position below the water level in the well but above the top of the screened interval, if possible. Surging action should be initiated very gently to loosen obstructing sediment. As the circulation improves during the redevelopment, more vigorous surging should be undertaken.

6.4.6.2 After operating the surge block over a given depth for several minutes, lower it to the next interval and repeat the surging action. This process should be repeated until surge blocking has been conducted over the entire screened interval.

6.4.6.3 After surge-blocking the entire screened interval, the surge block should be removed. Install a suction-lift pump intake and a submersible pump or a foot-valve pump, and pump water from the well to remove the dislodged sediment. An effort should be made to pump accumulated sediment from the bottom of the well. Pumping should continue until the discharged water is clear and several bore volumes have been removed.

6.4.6.4 The process of surge blocking and then pumping should be repeated at least once. If the capacity of the well is not restored to near-original levels, or if the clarity of the well water fails to improve after only two surge-and-pump cycles, the complete process should be continued until the capacity of the well and the clarity of the water cease to improve.

6.4.7 *Suction-Lift Pumping*

6.4.7.1 Suction-lift pumping is most suitable to use in combination with either surge-blocking or nitrogen-jetting. When used with either of these techniques, suction-lift pumping is an effective means of removing suspended sediment particles and accumulated sediment that have collected at the bottom of a well. When used alone, suction-lift pumping is also capable of providing only limited improvement in the capacity of a well.

6.4.7.2 When using suction-lift pumping in combination with surging or jetting, the suction-lift pump should be used to remove any accumulated sediment from the bottom of the well. This should be done prior to surging or jetting. Subsequently, the suction-lift pump should be used after each surging or jetting cycle to remove loosened sediment particles. Suction-lift pumping is conducted by simply installing the intake line in the well, connecting it to the pump intake port, and turning on the pump. Suction-lift pumping should then continue until the discharge water is clear. Suction-lift pumping can only be used if the depth to water is less than approximately 25 to 30 feet.

6.4.7.3 When using suction-lift pumping as the sole means of development, "over-pumping" is used to remove entrapped sediment from the well screen, filter pack, and formation. For this approach, the intake line is installed at the bottom of the well, and the well is pumped at its maximum rate for extended periods (in excess of 10 minutes) and then allowed to recover. The process is repeated until maximum improvements in capacity and/or well-water clarity have been achieved.

6.4.8 *Submersible Pumping*

6.4.8.1 Submersible pumps may also be used in conjunction with surging or jetting for well development. Submersible pumps are not as effective as suction-lift pumps for pumping water with large amounts of suspended sediment (particularly sand-size sediment). Additionally, submersible pumps cannot be used to pump accumulated sediment from the bottom of a well. For this reason, submersible pumping should not be used as the sole means of developing a well, as can be done when using a suction-lift pump. The sequence of surging or jetting and submersible pumping should continue until the capacity of the well and the clarity of the water cease to increase.

6.4.8.2 When using a submersible pump in conjunction with surging or jetting, the pump should be installed after completion of each surging or jetting episode. To provide for maximum removal of suspended sediment, the submersible pump should be lowered to the bottom of the well on a suspension cable. For small pumps and shallow wells, the cable can be lowered by hand. For large pumps or deep wells, the weight of the pump and the discharge hose requires that a cable reel mounted on a tripod or vehicle be used for lowering and retrieving the pump.

6.4.8.3 After the pump is lowered into position, the electrical cord should be connected to a power supply. Do not connect the electrical cord to the power supply until the pump is installed in the well. Some submersible pumps are not grounded and could electrocute an individual if the pump is touched while turned on. After turning on the pump, continue pumping until the discharge water is clear.

6.4.8.4 After the discharge water becomes clear (or ceases to improve) and the pump is disconnected from the power supply, remove the pump by lifting or cranking up the suspension cable. The pump should never be removed by lifting or pulling on the electrical cord or the discharge hose.

6.4.9 *Foot-Valve Pumping*

6.4.9.1 A foot-valve pump is simply a length of semirigid hose or pipe with a foot valve attached to one end. A foot-valve pump uses the momentum of water contained in the "discharge line" to lift water from the well as the discharge line is rapidly moved up and down. The foot valve on the bottom opens during the downstroke, allowing water to enter the discharge line. During the upstroke, a spring in the valve, combined with the weight of the water, forces the valve closed. A foot-valve pump can be used in conjunction with surging or jetting to remove entrapped sediment particles from a well. Foot-valve pumping is very effective for removing sand-size particles. The method is also very effective in removing accumulated sediment from the bottom of a well prior to initiating surging or jetting activity.

6.4.9.2 When using a foot-valve pump in conjunction with surging or jetting, the sediment in the bottom of the well should be removed prior to initiating surging or jetting activities. Install the foot-valve pump so that the lower end of the unit (the valve end) is at the bottom of the well. Commence pumping by rapidly raising and lowering the discharge line. As the line fills with water, its weight will increase. For shallow wells, this operation of the pump can be accomplished manually. For deep wells, the weight of the discharge line will require a mechanical means of raising and lowering the unit. Such mechanical devices typically consist of a specially made jack handle or a commercially made apparatus.

6.4.9.3 Once the initial pumping effort begins to produce water, pumping should continue until the discharge water is clear.

6.4.9.4 Surging or jetting should then be conducted, followed by another episode of foot-valve pumping. This sequence of steps shall be repeated until the capacity of the well and the clarity of the water cease to increase.

7. Precision and Bias

7.1 This standard practice presents guidelines for maintaining high-quality monitoring-well installations. Therefore, statements regarding precision and bias are not applicable, except in the context of such statements that might be included in Standard Test Method for the Measurement of Water Levels in Groundwater Monitoring Wells [LQ–2(T)].

8. Quality Assurance

8.1 To maintain quality control standards, the Well Maintenance Checklist must be completed for each well that undergoes inspection and maintenance. The checklist must be signed by the person completing the checklist. The checklist should then be reviewed for correctness and completeness by the assistant well-maintenance technician. Any discrepancies should be corrected by the two well-maintenance technicians, and the assistant should sign the form as having verified the information. The checklist should then be filed in the Project Well Maintenance File.

9. Keywords

9.1 Air-lift pumping, foot-valve pumping, monitoring well, nitrogen-jetting, submersible pumping, surge-blocking, well inspection, well-maintenance, and well redevelopment.

Environmental Procedures Catalog

Document Addition/Revision

Procedure Title Standard Test Method for the Field Measurement of Specific Conductance[LQ-5(T)], Rev. 1, 4/92

Requester Sam Campbell

Justification A three point operational check is required to determine if the instrument is responding properly through a wide range of conductivities. However, this three point check is not necessary at every sampling site due to the limited range of conductivities expected.

Proposed Changes (list here or attach copies) Section 7 - A three point conductivity check will be performed on each probe at the start of the sampling day. After the initial check, a one point check with a 1000 umhos/cm solution will be performed at each sampling location prior to sampling. The three point check may also be conducted using commercially available KCl solutions of 100 umhos/cm, 1000 umhos/cm and 10,000 umhos/cm.

New Document

Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned ______

______ ______

Manager, Compliance Management *Date*

Project-Specific Change for Operable Unit III Annual Monitoring Program

Project

Reviewed by T E Bartlett 2/25/97 Approved by [signature] 2/25/97

Technical Author or Senior Proficient Designee *(date)* *Manager or Designee* *(date)*

Effective Date 4/1/97

GJO 1787
2/97

Standard Test Method for the Field Measurement of Specific Conductance

Introduction

Specific conductance is a widely used indicator of water quality. It measures the ability of water to carry an electrical current under specific conditions. This ability depends on the presence of ions and their total concentration, mobility, and temperature. Specific conductance is a simple indicator of change within a system and is used as an aid in evaluating whether a sample is representative of the water in the system.

1. Scope

1.1 This procedure describes the field measurement of the specific conductance of an aqueous sample. The specific conductance is measured using a conductance meter and a platinum or stainless steel electrode.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the planning documents for a particular project.

3. Referenced Documents

3.1 American Public Health Association, American Water Works Association, and Water Pollution Control Federation, *Standard Methods for the Examination of Water and Wastewater: American Public Health Association*, Washington, D.C., 1980.

3.2 Korte, N. and D. Ealey, *Procedures for Field Chemical Analyses of Water Samples*, Technical Measurements Center, U.S. Department of Energy, Grand Junction Area Office, GJ/TMC–07(83), 1983.

3.3 Wood, W.W., "Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents," *Techniques of Water-Resources Investigations of the United States Geological Survey*, Chapter D2, Book 1: U.S. Government Printing Office, Washington, D.C., Stock Number 024–001–02879–4, 1976.

4. Significance and Use

4.1 The specific conductance or conductivity of a sample is defined as the conductance of the sample between opposite sides of a cube, 1 centimeter (cm) in each direction. Because it is impractical to build electrodes with these characteristics, electrodes are manufactured in various forms. A cell constant is determined by measuring a solution of known conductivity. Solutions of known conductivity are purchased or can be made from reagent-grade KCl. Samplers shall consult operating instructions for the specific instrument used for the determination of the cell constant. This conductivity is expressed in micromhos per centimeter (μmhos/cm).

5. Intereferences

5.1 Temperature, ionic strength, and the determination of the cell constant are features that affect the measurement of conductivity.

5.1.1 *Temperature*—The conductivity of a solution increases with temperature at approximately 2 percent per degree celsius. Significant errors can result from inaccurate temperature measurements.

5.1.1.1 If the conductivity meter does not have automatic temperature correction, the sampler can use the following formula to correct the conductivity reading for temperature:

$$K = \frac{Em}{1 + 0.0191(t - 25)}, \qquad (1)$$

where

K = corrected conductivity in μmhos/cm,

Em = measured conductivity in μmhos/cm, and

t = temperature in °C.

5.1.2 *Ionic Strength*—The conductivity of a solution is a function of the concentration and charge of the ions in solution and of the rate at which the ions move under the influence of an electrical potential. As the ionic strength increases, the rate at which the individual ions move decreases. Conductivity varies linearly with ionic strength for values below 1,000 μmhos/cm. As conductivity increases above 5,000 μmhos/cm, the line curves significantly; beyond 50,000 μmhos/cm, the conductivity is an unsatisfactory index of ionic concentration.

5.1.3 *Cell Constant*—The cell constant shall be checked and verified on a regular basis. A significant change in the cell constant indicates that the electrode needs cleaning or changing. Consult the instrument operating manual for procedures to check the cell constant, or see Section 7 of this procedure.

6. Apparatus

6.1 Specific conductance meter capable of measuring conductivity in the range of 0 to 100,000 μmhos/cm. This meter should also measure temperatures in the range of –5 °C to 50 °C.

6.2 Conductivity check solutions. Normally, 0.001 N, 0.01 N, and 0.1 N KCl solutions will cover the range of expected sample conductivity.

6.3 Distilled or deionized water in a squeeze bottle.

6.4 Disposable beakers, test tubes, or centrifuge tubes.

6.5 Kimwipes or equivalent lint-free tissue.

7. Calibration

7.1 An actual calibration of the instrument is not performed. The cell/instrument calibration is confirmed by use of standard check solutions as described below.

7.1.1 Connect the temperature probe and conductivity cell to the instrument.

7.1.2 Rinse the temperature probe and conductivity cell with distilled water and blot dry with a lint-free tissue.

7.1.3 Place the temperature probe and conductivity cell in the 0.001 N KCl standard and allow the readings to stabilize. Record the temperature and conductivity reading in the field logbook.

7.1.4 Repeat steps 7.1.2 and 7.1.3 for the 0.01 N and the 0.1 N KCl standards.

7.1.5 Correct the readings to 25 °C using the formula in Section 5.1.1.1 and compare these readings to the standard values. If these readings are within ± 10 percent of the accepted value, the cell instrument-calibration check is acceptable.

7.1.6 If the cell/instrument calibration check is unacceptable, consult the instrument operation manual for cell cleaning and instrument troubleshooting procedures.

8. Procedure

8.1 The following general procedure is supplemental to the instructions in the instrument-specific operating manual.

8.1.1 Rinse the conductivity cell and temperature probe with several volumes of sample water.

8.1.2 Immerse the probe and cell in the sample.

8.1.3 Allow the readings to stabilize and record the temperature and conductivity readings on the field log form.

8.1.4 Remove the probes from the solution, rinse with distilled water, blot dry, and store according to the manufacturer's recommended procedures.

9. Quality Assurance

9.1 The following information about the field measurement of specific conductance shall be logged for quality-assurance documentation.

9.1.1 Source and expiration date of standards.

9.1.2 Instrument manufacturer and model number.

9.1.3 Date and time of calibration check.

9.1.4 Temperature and conductivity of standards used to check calibration.

9.1.5 Sample temperature and conductivity reading.

9.1.6 Name of person performing the measurement.

10. Precision and Bias

10.1 Precision and accuracy of ± 5 percent can be achieved with this procedure at conductivity readings between 100 and 5,000 μmhos/cm.

Readings between 0 and 100 μmhos/cm and above 5,000 μmhos/cm should provide ± 10 percent precision and accuracy. Readings above 20,000 μmhos/cm shall not be attempted with this procedure.

11. Keywords

11.1 Conductivity, ionic strength, and specific conductance.

Technical Comments on ASTM D 1889–88a
Standard Test Method for Turbidity of Water

Summary of ASTM D 1889–88a

This test method describes the measurement of turbidity in water and wastewater discharges using two types of instrumentation.

Additions Applicable to Operating Contractor and Its Subcontractors

This addendum addresses specific procedures, equipment, and documentation requirements when using the HACH model 2100P portable turbidimeter to measure turbidity of ground water.

The following sections shall be interpreted in conjunction with the current published version of this ASTM procedure. These sections shall be interpreted in numerical order, using the published version as the base document for reference.

1. Scope

1.2.1 Turbidities up to 1000 NTU can be accurately measured using the HACH model 2100P portable turbidimeter.

1.3.1 Turbidities greater than 1000 NTU may be measured using the HACH model 2100P portable turbidimeter by serial dilution to below 1000 NTUs.

2. Referenced Documents

2.3 HACH Company Manual, *Model 2100P Portable Turbidimeter Instruction Manual*, Loveland, CO, 1992.

3. Terminology

3.2.2 *Turbidimeter*—An instrument used to measure the turbidity of an aqueous sample.

4. Significance and Use

4.3 Turbidity measurements are used as indicators of the effectiveness of well-development activities. Turbidity measurements also are used to determine when purging of a monitoring well is complete and ground water sampling can commence.

8. Interferences

8.3.1 Periodically apply a thin layer of silicone oil to the sample cell to mask minor imperfections and scratches in the glass.

9. Apparatus

9.5 *Portable turbidimeter:*

9.5.1 HACH model 2100P portable turbidimeter.

9.5.2 Glass sample cells.

9.5.3 Silicone oil.

9.5.4 AEPA–I styrene/divynlbenzene polymer primary standard or Formazin primary calibration solution.

9.5.5 Gelex secondary turbidity standards.

9.5.6 Battery eliminator.

9.5.7 Logbook.

9.5.8 Kimwipes or equivalent lint-free tissue.

10. Reagents

10.3 Routine primary calibration of the HACH 2100P turbimeter requires 0, 20, 100, and 800 NTU solutions.

11. Calibration

11.1 A primary calibration of the turbidimeter must be conducted before each sampling event.

11.2.1 Press the input/output (I/O) switch to turn the power on.

11.2.2 Fill a clean sample cell with the same dilution water used to prepare the standards, or the 0 NTU standard.

11.2.4 Close the lid and press the CAL key followed by the READ key. The turbidimeter will read the value of the dilution water or the 0 NTU standard and use this value to calculate a correction factor for the 20 NTU standard.

11.2.5.1 The display will automatically advance to the next standard and show "20 NTU." Remove the dilution water or 0 NTU solution sample from the cell compartment and replace it with a sample cell containing the 20 NTU standard (orientation marks should always be aligned). Press the READ key.

11.2.6.1 The display will automatically advance to the next standard and show "100 NTU." Remove the 20 NTU standard from the cell compartment and replace it with a sample cell containing the 100 NTU standard. Press the READ key.

11.2.6.2 The display again will advance to the next standard and show "800 NTU." Remove the 100 NTU standard from the cell compartment and replace it with a sample cell containing the 800 NTU standard. Press the READ key.

11.2.7.1 After the display reads "SO," press the CAL key to complete the calibration and store the calibration information within the electronics of the turbidimeter.

12. Procedure

12.1 *Operational check with Gelex secondary standards.* When using a HACH model 2100P portable turbidimeter, the following steps replace section 12.1 found in the ASTM procedure.

12.1.1 After every primary calibration, values must be assigned to the Gelex standards for use in operational checks.

12.1.2 Clean the outside of the Gelex cells and apply a thin coating of silicone oil.

12.1.3 Place each of the Gelex standards in the cell compartment with the orientation marks aligned and press the READ key. Record the displayed value in the project logbook and mark the value on the cell above the band.

12.1.4 Before taking measurements, the turbidimeter must be operationally checked by placing the Gelex standards in the cell compartment and pressing the READ key. The displayed value must be within 10 percent of the assigned Gelex value obtained during primary calibration. If the value falls outside the 10 percent criteria, a new primary calibration must be performed.

12.2.2 Turbidities up to 1000 NTUs can be measured without dilution of the sample using the HACH model 2100P portable turbidimeter.

12.2.3.2 Apply a thin film of silicone oil to the sample cell and wipe with a Kimwipe.

12.2.3.3 Place the sample cell in the instrument cell compartment with the orientation marks aligned.

12.2.3.4 Select manual or automatic range by pressing the RANGE key.

12.2.3.5 If the sample causes the display to change constantly, press the SIGNAL AVERAGE key.

12.2.3.6 Press the READ key. The display will show the turbidity in NTU. Record the value as specified in the project planning documents.

14. Precision and Bias

14.6 Accuracy of ± 2 percent and a repeatability of ±1 percent, or ± 0.01 NTU (whichever is greater) can be expected using the HACH model 2100P portable turbidimeter.

15. Quality Assurance

15.1 Documentation for quality-assurance purposes when making turbidity measurements includes the following information:

15.1.1 Date and time of the primary calibration.

15.1.2 Manufacturer, expiration date, and NTUs of the primary calibration standards.

15.1.3 Values assigned to the Gelex secondary standards after the primary calibration.

15.1.4 Measurements of the Gelex standards prior to making the turbidity measurement.

15.1.5 Date and time of the turbidity measurement.

15.1.6 Measured sample turbidity.

15.1.7 Instrument manufacturer, model, and serial number of the turbidimeter.

15.1.8 Name of person performing the measurement.

16. Keywords

16.1 Calibration, nephelometric, NTU, turbidity, and turbidimeter.

17. Hazard Analysis

17.1 This test method may use Formazin for the preparation of calibration standards. Avoid contact with skin and eyes; use adequate eye protection and disposable gloves.

17.2 Site-specific controls are available in the planning documents for a particular project.

Designation: D 1889 – 88a

Standard Test Method for Turbidity of Water[1]

This standard is issued under the fixed designation D 1889; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue that has been adopted by the Department of Defense.

1. Scope*

1.1 This test method covers the determination of turbidity in water and wastewater.

1.2 This test method is applicable to the measurement of turbidities in the range from 0.05 to 40 nephelometric turbidity units (NTU).

1.3 Higher turbidities may be measured using this test method by serial dilution to applicable range.

1.4 This test method was tested on municipal drinking water and final effluent discharges. It is the user's responsibility to ensure the validity of this test method for waters of untested matrices.

1.5 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For a specific caution statement, see Note 3.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1129 Definitions of Terms Relating to Water[2]

D 1192 Specification for Equipment for Sampling Water and Steam[2]

D 1193 Specification for Reagent Water[2]

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water[2]

D 3370 Practices for Sampling Water[2]

2.2 *EPA Standard:*

EPA 600/4-79-202 Methods for Chemical Analysis of Water and Wastes[3]

3. Terminology

3.1 *Definitions*—The terms turbidity, and nephelometric turbidity are defined in Definitions D 1129. For definitions of other terms used in this test method, refer to Definitions D 1129.

3.2 *Description of Term Specific to This Standard:*

3.2.1 *turbidity*—an expression of the optical properties of a sample that causes light rays to be scattered and absorbed rather than transmitted in straight lines through the sample. (Turbidity of water is caused by the presence of suspended and dissolved matter such as clay, silt, finely divided organic matter, plankton, other microscopic organisms, organic acids, and dyes.)

4. Significance and Use

4.1 Turbidity in water is caused by the presence of suspended and dissolved particles of gas, liquid or solids of organic or inorganic matter. Turbidity is undesirable in drinking water, plant effluent waters, water for food and beverage processing, and for a large number of other water-dependent manufacturing processes. Removal of suspended matter is accomplished by coagulation, settling, and filtration. Measurement of turbidity provides a rapid means of process control for when, how, and to what extent the water must be treated to meet specifications. Methodology for the correlation of a sample NTU to the number or volume of suspended particles is now under evaluation. Specific gravity estimates would then give rapid NTU correlation to the weight concentration of suspended matter.

4.2 This test method is suitable to low and medium turbidity such as that found in drinking water and process water.

5. Summary of Test Method

5.1 *Nephelometric Turbidity:*

5.1.1 *Photoelectric Nephelometer*—The photoelectric nephelometer operation is based on instrumental comparison of the intensity of light scattered by the contained static water sample under defined conditions to the intensity of light scattered by a reference standard in the sample container. The higher the intensity of scattered light, the higher the turbidity of sample.

5.1.2 *Calibrated Slit Turbidimeter*—The calibrated slit turbidimeter operation is based on a visual comparison of the intensity of light scattered by the contained static water sample under defined conditions to the intensity of light scattered by a reference sample in the same container, the higher the intensity of scattered light the higher the turbidity of sample.

5.1.3 *Nephelometric Turbidity Standards:*

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[1] This test method is under the jurisdiction of ASTM Committee D-19 on Water and are the direct responsibility of Subcommittee D19.07 on Sediments.

Current edition approved June 24, 1988. Published September 1988. Originally published as D 1889 – 61. Last previous edition D 1889 – 88.

[2] *Annual Book of ASTM Standards*, Vol 11.01.

[3] Available from Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

* A Summary of Changes section appears at the end of this test method.

5.1.3.1 AEPA-I styrene/divinylbenzene polymer standard (see Section 2). These standards are used as received from the distributor.[4]

5.1.3.2 Formazin polymer preparation and dilution methods are given in 10.2.2 to 10.2.4.

6. Purity of Reagents

6.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[5] Other grades may be used providing it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 Unless otherwise indicated references to water shall be understood to mean reagent water conforming to reagent water Type III Specification D 1193.

6.2.1 Standard dilution waters of Type III shall be prepared by filtration through a 0.2 to 0.22 µm membrane or other suitable filter within 1 h of use to reduce background turbidity to less than 0.05 NTU.

7. Sampling and Sample Preservation

7.1 *Collection of Sample*—Collect the sample in accordance with the applicable standard, Specification D 1192 and Practices D 3370 or EPA 600/4-79-202 for EPA compliance.

7.2 *Storage of Sample*—Determine the turbidity on the day the sample is taken. If this is not feasible, store the sample in the dark for up to 24 h and refrigerate at 4°C if possible, but do not freeze. Prolonged storage is not recommended because of irreversible changes.

7.3 *Preparation of Sample*—Bring the sample to room temperature and shake sample vigorously for at least 1 min. Let the sample stand 2 to 3 min to allow air bubbles to disappear, then gently invert the sample several times or swirl mix before examination.

8. Interferences

8.1 Floating or suspended large particles and entrained air bubbles will give false or unstable readings. Certain turbulent motions also create unstable reading conditions of nephelometers.

8.2 Dissolved material that imparts a color to the water may cause serious errors in nephelometric reading unless the instrument has special compensating features.

8.3 Scratches, finger marks, or dirt on the walls of the sample cell may give erroneous readings. Cells should be kept scrupulously clean both inside and outside and discarded when they become etched or scratched. The cells must not be handled where the light strikes them when indexed in the instrument well.

NOTE 1—The same indexed cell should be used first for standardization followed by unknown determination.

NOTE 2—Indexing of the sample cell or tube to the instrument well is accomplished by placing a mark on the top of the glass cell and a similar mark on the upper surface of the well so that the cell can be placed in the well in an exact position each time.

9. Apparatus

9.1 Two types of instruments are available for the nephelometric method, the photoelectric nephelometer and the calibrated slit turbidimeter (Figs. 1 and 2). Both give a greater precision and sensitivity than the Jackson candle turbidity, within their applicable range from 0.05 to 40.0 NTU, to ranges as low as 0.05 to 1.00 NTU.

9.2 The sensitivity of the instruments should permit detection of differences of 0.02 NTU or less in waters having turbidities of less than 1.00 NTU. The instrument should measure the ranges from 0.05 to 1.00 NTU and 0.05 to 40.0 NTU with the additional ranges from 0.05 to 0.10 and 0.05 to 10.0 NTU if possible. Linear calibration charts should be made for each range used. Either of the two accepted standards, AEPA-I or Formazin, (10.2.1 or 10.2.2) can be used for this calibration. See 11.1 for calibration instruments.

9.3 *Photoelectric Nephelometer:*

9.3.1 This instrument uses a light source for illuminating the sample and one or more photoelectric detectors with a readout device to indicate the intensity of light scattered at right angles (90°) to the path of the incident light. The photoelectric nephelometer should be so designed that little stray light reaches the detector(s) in the absence of turbidity and should be free from significant drift after a short warm-up period.

9.3.2 Differences in physical design of photoelectric nephelometers will cause differences in measured values for turbidity, as will aging of a turbidimeter, even though the same suspension is used for calibrations. To minimize initial differences, the following design criteria should be observed (see Fig. 1).

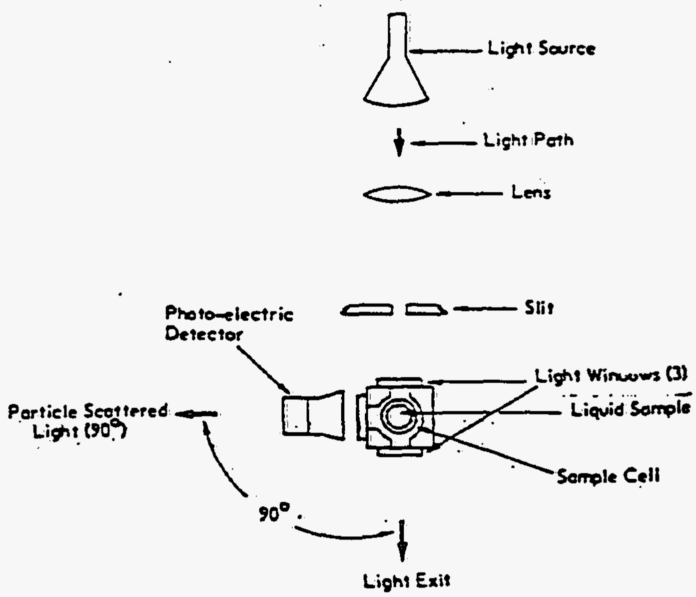
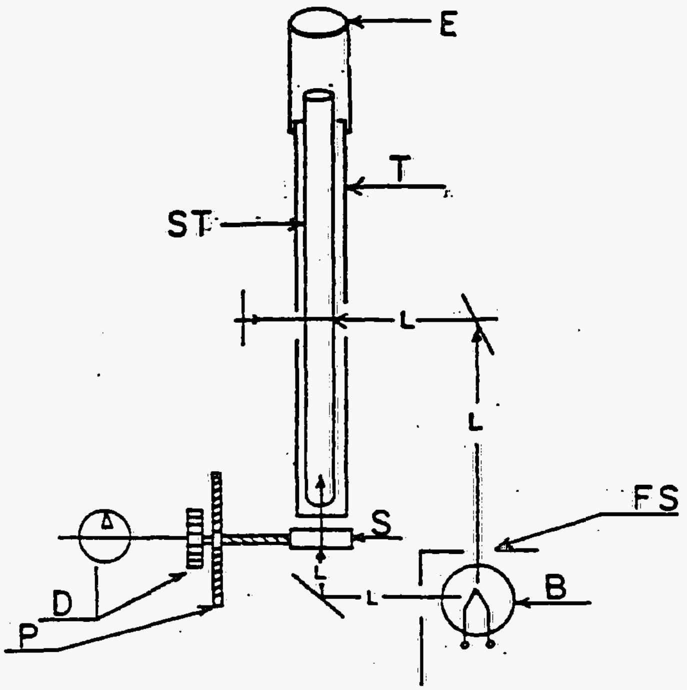


FIG. 1 Photoelectric Nephelometer

[4] Patents 4,283,143 and 4,291,980, available from, Advanced Polymer Systems, Inc., 3696 Haven Ave., Redwood City, CA 94063, have been found satisfactory for this purpose.

[5] "Reagent Chemicals, American Chemical Society Specifications," Am. Chemical Soc., Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."



NOTE—B—bulb
T—cell
S—slit
D—dial
P—calibrated plate
ST—sample cell
E—eye piece
FS—fixed slits
L—light paths

FIG. 2 Calibrated Slit Turbidimeter

9.3.2.1 *Light Source*—Tungsten lamp operated at a color temperature between 2200 and 3000 K.

9.3.2.2 Distance traversed by incident light and scattered light within the sample, total not to exceed 10 cm.

9.3.2.3 *Angle of Light Acceptance to the Detector*—Centered at 90° to the incident light path and not to exceed ±30° from the 90° scatter path center line.

9.3.3 The sample tube used in calibration and sample measurement must be the following:

9.3.3.1 Clear, colorless glass, be kept scrupulously clean, both inside and out, and discarded when it becomes etched or scratched.

9.3.3.2 Index marked so that repeated exact placements into the instrument cuvette well for measurement can be made.

9.3.3.3 Handled where the light path does not pass during measurement. Provision should be made in design to give the tube a proper place in which to handle the tube during calibration or sample measurement procedure. Instrument and sample tube design criteria are given in EPA 600/4-79-202.

9.4 *Calibrated Slit Turbidimeter:*

9.4.1 This instrument uses principles based on the Tyndall effect. A beam of light passing up through the sample is compared to the light scattered upward by suspended particles in the turbid solution which has been illuminated from the side at 90°.

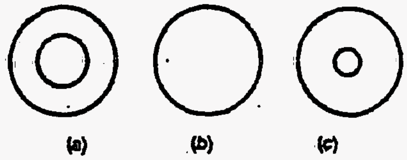


FIG. 3 Eye Piece Fields (Calibrated Slit)

9.4.2 As shown in Fig. 2, light from the bulb, *B*, is reflected to illuminate the turbid solution in the cell, *T*, from the side. Light scattered upward by the suspended particles in the solution is seen through an eye piece as the outer portion of a circular split field (as in Fig. 3). Light also passes through a dial operated adjustable slit, *S*, and is reflected upward through the sample. In the eye piece this light is seen as the center circular field. Depending on the amount of light permitted through the adjustable slit, the center field will appear higher or darker than the outer portion, as shown in Fig. 3(*a*) and 3(*c*). The operator turns the dial controlling the slit until the entire field is of uniform brightness as shown in Fig. 3(*b*). Dial calibration charts should be based on at least five concentration levels, (across the 0.05 to 40 NTU range) of prepared AEPA-I or in-house fresh preparations and dilutions of Formazin. 40 NTU has been selected by EPA as the maximum concentration or turbidity that is the upper limit of linearity for measuring instruments even though there are some instruments that are linear above 40 NTU.

NOTE 3: Caution—Care should be exercised if Formazin standardization is used as Formazin has a rapid settling rate, so sample should be remixed at least every 15 min.

9.4.2.1 From this prepared chart slit dial reading can be translated into NTU values. Prior to unknown water sample determination, a single standard point determination should be made to check cell cleanliness and other instrument optics, such as lamp operation.

9.4.2.2 Because the eye is used to detect the null-point, the observer can compensate and disregard the presence of sample color and extraneous debris.

10. Reagents

10.1 Dilution and final rinsing water, see 6.2.

10.2 *Turbidity Standards:*

10.2.1 AEPA-I turbidity standards are prepared sealed stable suspensions of styrene divinylbenzene which are opened and used as received from manufacturer. Note that all standard Formazin diluted concentrations of AEPA-I are available from the manufacturer.

NOTE 4—Sealed or solid samples will not standardize nephelometers for the turbidity measurement of water or waste. These two methods (sealed or solid examples) neglect the zeroing out of sample tube (cuvette) prior to making water measurement in the tube.

10.2.2 *Formazin Turbidity Suspension, Stock (400 NTU)*—A stock turbidity suspension for Formazin polymer is prepared by reacting hydrazine sulfate with hexamethylenetetramine under carefully controlled conditions. (See EPA 600/4-79-202.)

10.2.2.1 *Solution I*—Dissolve 1.00 of hydrazine sulfate [$(NH_2)_2H_2SO_4$] in dilution water and dilute to mark in a 100-mL volumetric flask.

10.2.2.2 *Solution II*—Dissolve 10.0 of hexamethylenetetramine (practical grade, ACS grade not available) in dilution water and dilute to mark in a 100-mL volumetric flask.

10.2.2.3 Into a third 100-mL volumetric flask, pipet 5.00 mL of Solution I and with a clean pipet add 5.00 mL of Solution II. Mix the two solutions and allow to stand for 24 h at 25 ± 3°C. After reaction, dilute to mark with water and mix. The freshly mixed turbidity of this solution is 400 NTU. This 400 NTU stock has to be prepared monthly.

10.2.3 *Formazin Turbidity Suspension, Standard (40 NTU)*—Pipet 10.0 mL of mixed 400 NTU stock into a 100-mL volumetric flask and dilute with water to mark. The turbidity of this suspension is defined as 40 NTU. This 40 NTU suspension has to be prepared weekly.

10.2.4 *Dilute Formazin Turbidity Suspension Standard*—Prepare dilute turbidity suspension below 4.0 NTU daily. Those above 4.0 NTU have a useful life of one week. Prepare each dilution by pipetting the volume of 40 NTU into a 100-mL volumetric flask and diluting to mark with water; so that 50.0 mL of 40 NTU diluted to 100 mL is 20.0 NTU and 10.0 mL of 40 NTU diluted to 100 mL is 4.00 NTU.

10.2.4.1 To prepare dilute suspensions having turbidities of less than 1.0 NTU use an appropriate volume of 4.0 NTU suspension in a 100-mL volumetric flask and dilute to mark. Prepare dilutions below 4.C NTU daily.

11. Calibration

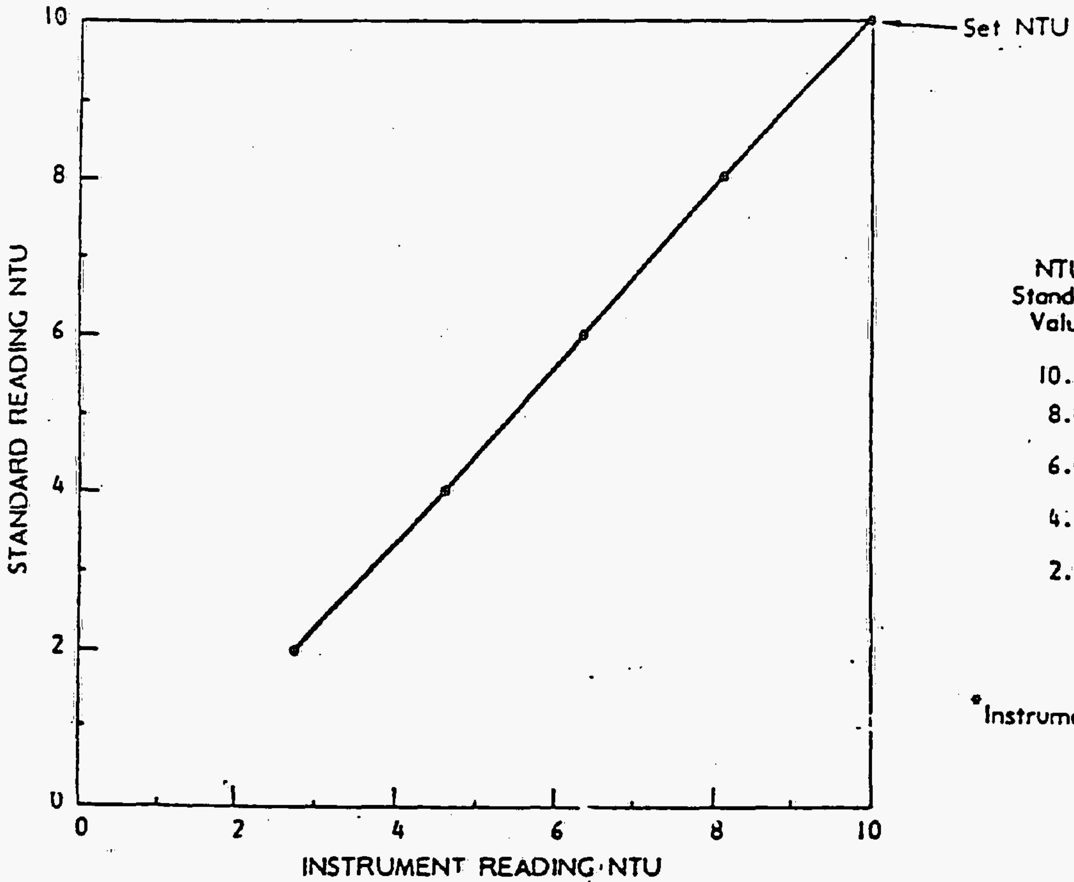
11.1 Follow the manufacturer's operating instructions. Calibrate the instrument range of interest with standards (see AEPA-I and Formazin standards). If the instrument control dial, meter, or output digital reading is already in NTUs, this procedure and curve will check the accuracy of the instrument output. Use at least three standard concentrations (NTU) to calibrate each instrument range. Photoelectric nephelometers have a calibration adjustment. Set this adjustment to equal the high value of standard for the range of interest. Read the standards used for the calibration of the range in the same tube as was the high level adjustment. Note and graph the instrument value for each standard (instrument reading versus standard value). See Fig. 4 as an example. For daily use of the instrument, one standard in the use range will be all that is required to set the calibration adjustment at the graph reading for that value. The aging drift characteristics of each instrument will determine the recalibration requirement.

11.1.1 Clean the cell after filling with turbidity standard or test water samples as follows:

11.1.1.1 Rinse the clean dry cell twice with the suspension with which it is to be filled.

11.1.1.2 Fill the cell to a level to where the top air-liquid interface will not interfere with the subsequent reading. Check manufacturer recommendations as to cell filling.

11.1.1.3 After the cell is filled, tissue is then used to remove all traces of dirt or fingerprints. Tissue alone does not clean very dirty cells and one of the common nonabrasive glass cleaners may be necessary.



Table

NTU Standard Value	NTU Instrument Reading
10.0	10.0*
8.0	8.1
6.0	6.3
4.0	4.7
2.0	2.8

*Instrument adjusted to read this value

FIG. 4 Linear Calibration LC-10

11.1.1.4 The cleaned cell is handled by its very top and placed in an indexed manner in the instrument.

11.2 *Calibration Steps:*

11.2.1 Warm up the instrument according to manufacturer's instructions.

11.2.2 Rinse a clean, dry, scratch-free index marked cell with the highest concentration of the standard for the instrument range setting or range of interest, and then fill. Always clean the exterior of the cell after filling in any of the following procedures.

11.2.3 Place the cell in the instrument in an oriented manner ready for reading of turbidity.

11.2.4 For photoelectric nephelometrics, set the calibration adjustment for the labeled value of AEPA-I turbidity standard or the diluted value of Formazin standard. For slit type nephelometers plot the adjusted dial reading at null or uniform field brightness versus NTU value of turbidity standard.

11.2.5 Remove the sample cell and discard the first turbidity standard. Rinse and fill a second value of turbidity standard and place the cell in the instrument in an oriented manner. Without moving the photo-electric calibration adjustment, make a reading. Plot this instrument NTU reading against the NTU value of the turbidity standard. For the slit type nephelometer again plot the adjusted dial reading at null versus NTU value of the turbidity standard.

11.2.6 Repeat for at least one more turbidity standard NTU value which should cover the turbidity range of interest. The greater the number of turbidity standard values used, the greater the reliability of the calibration.

11.2.7 Make the plot of instrument reading or dial setting versus turbidity standard NTU value to where any instrument reading or dial setting within the range calibrated is corrected to values relative to the turbidity standard values. The plot of instrument reading or dial setting versus turbidity standard value is a range calibration curve. Calibration curves for each usable range should be made. See Fig. 4 for an example of a linear calibration curve.

12. Procedure

12.1 Standardize the instrument with one value (NTU) of turbidity standard in the measurement range of interest.

12.1.1 Warm up the instrument according to the manufacturer's instructions.

12.1.2 Rinse a clean, dry, scratch-free index marked (a felt pen dot) cell with a turbidity standard (AEPA-I or Formazin) with a value (NTU) in the range of interest. Fill the cell with this turbidity standard. Clean the cell's exterior.

12.1.3 Place the filled clean cell in an indexed manner in the instrument and read the value. It will be an NTU reading for photoelectric types and a dial reading for slit types nephelometers.

12.1.4 From the calibration curve for this instrument's range, determine the required reading for the turbidity standard in cell.

12.1.4.1 Move calibration adjustment to give the photoelectric nephelometer the required NTU reading.

12.1.4.2 The slit dial reading determined from the calibration curve for the turbidity standard in the cell should be within 5 % of the dial reading. If not, reclean the cell and recalibrate.

12.2 *Measurement of Water Turbidity:*

12.2.1 *Turbidity Less Than 40 NTU*—Shake the sample to thoroughly disperse the solids. Allow air bubbles to disappear, then proceed.

12.2.2 *Turbidity Exceeding 40 NTU*—Dilute the sample with one or more equal volumes of reagent water until turbidity is below 40 NTU after mixing and degassing. Then treat this less than 40 NTU turbidity in accordance with 12.2.1. The turbidity of the original sample can then be computed based on dilution data and original sample volume (variations of particle size can affect dilution).

12.2.3 After calibration check or adjustment, empty the cell (do not change cells for measurement) of turbidity standard and rinse the empty cell with the water sample to be tested.

12.2.3.1 The measured NTU value of the water sample is determined using the instrument value and the appropriate calibration curve.

13. Report

13.1 Report results as follows:

NTU	Report to Nearest (NTU)
0.05–1.00	0.05
1.00–10.0	0.1
10.0–40	1.0
40–100	5.0
100–400	10
400–1000	50
>1000	100

14. Precision and Bias[6]

14.1 Round-robin data for this test method were obtained by the use of AEPA-I standards. EMSL (Environmental Monitoring and Support Laboratory, EPA, Cincinnati, Ohio) examined this data for its statistical significance. For other matrices, these data may not apply.

14.2 Formazine was not used in the round-robin test because of its short term stability. Formazine can be used as a fresh short-term calibration mixture but the results might not be applicable to this collaborative test study.

14.3 Polymer suspensions of sytrene divinyl-benzene are stable and can be accurately quantitated by gravimetric procedures. Linear calibration of each instrument was performed prior to collaborative study, involving ten laboratories and three nephelometric turbidity unit (NTU) levels.

14.4 Table 1 shows the required statistical treatment of the turbidity round-robin test for nine laboratories and three concentrations of NTUs and one laboratory's results were statistically rejected.

14.5 Table 2 shows that the bias of all NTU levels is insignificant for the round-robin test.

[6] Supporting data are available from ASTM Headquarters. Request RR: D19-1129.

TABLE 1 Final Statistics[A]

True concentration, C	0.92	4.50	18.66
Mean response, $\bar{X}$	0.972	4.410	18.57
Bias, $\bar{X} - C$	0.052	−0.090	−0.09
Total standard deviation, S_T	0.091	0.361	0.292
Single-operator standard deviation, S_o	0.044	0.174	0.181

[A] Represent three concentrations of NTU.

TABLE 2 Bias Results

True concentration, C	0.92	4.50	18.66
Mean response, $\bar{X}$	0.972	4.410	18.57
Bias = $\bar{X} - C$	0.052	−0.090	−0.09
Total standard deviation, S_T	0.091	0.361	0.292
Number of lab/operators contributing usable data, n	8	8	8
Student's t-value, $t = \mid \text{bias} \mid / (S_T/\sqrt{n})$	1.62	0.71	0.87
Critical t-value from Table X3.8 of Practice D 2777	2.365	2.365	2.365
Is bias significant, is $t >$ critical t?	no	no	no

SUMMARY OF CHANGES

This section identifies the location of selected changes to these test methods that have been incorporated since the last issue. For the convenience of the user, Committee D-19 has highlighted those changes that may impact the use of these test methods. This section may also include descriptions of the changes or reasons for the changes, or both.

(1) Former Test Method B (Visual Jackson Candle Turbidity) was deleted.

Standard Practice for Preparing or Revising Procedures for the *GJO Environmental Procedures Catalog*

1. Scope

1.1 This practice describes the preparation, review, approval, and distribution of procedures in the *GJO Environmental Procedures Catalog* (GJO 6).

1.2 The procedures in this catalog are not intended to address all of the details and variations that might apply to an individual project. Therefore, a site-specific plan or other project-specific document will describe in detail the work that will be performed and will identify procedures from the *GJO Environmental Procedures Catalog* that will be used.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 American Society for Testing and Materials, *Form and Style for American Society for Testing and Materials (ASTM) Standards*, 9th Edition, Philadelphia, PA, November 1994.

3.2 *GJO Environmental Procedures Catalog* (GJO 6):

> Procedure GN–4(P), "Standard Practice for Personnel Qualifications".
> Procedure GN–6(P), "Standard Practice for Quality Assurance".

4. Responsibilities

4.1 Manager, MACTEC-ERS Compliance Management has overall responsibility for the *GJO Environmental Procedures Catalog* as defined by Task Order.

4.2 Environmental Procedures Advisory Committee (EPAC)—A combined FOS/TAR contractor group of professionals with expertise in particular areas who serve as advisors to address questions and problems relevant to the *GJO Environmental Procedures Catalog* and the associated training.

4.3 EPAC Chair is head of EPAC and responsible for management of the catalog and implementation of the qualification system defined in Procedure GN–4(P).

4.4 EPAC Catalog/Training Coordinator is the point contact for procedure revisions and distribution. The current electronic and paper version of each procedure is maintained by the catalog coordinator. The coordinator also maintains the training qualifications and provides input to the Training Information System.

4.5 EPAC Technical Leads manage a section of the catalog. Their duties include assigning a key senior proficient person to each of the procedures, oversight for revisions to and reviews of procedures, and approval of project-specific changes to procedures.

5. Terminology

5.1 *Acceptance criteria*—Specified limits, requirements, or tolerances placed on the variation permitted in the characteristics of an item, process, report, data, or service as defined in codes, standards, drawings, specifications, procurement documents, or other requirements documents. The criteria must be definitive for decision-making purposes but might not be related to instruments or measurements.

5.2 *Environmental Procedures Advisory Committee (EPAC)–See paragraph 4.2.*

5.3 *Guide*—A procedure that outlines a suggested approach through a series of options or instructions but does not recommend a specific course of action.

5.4 *May*—In procedures, a suggestion only.

5.5 *Must*—In procedures, a required action. Synonymous with "shall" and "will".

5.6 *Planning document*—A document prepared to guide a project or task. These documents may be called Work Plans, Sample and Analysis Plans, project plans, or task plans, depending on sponsor requirements.

5.7 *Practice*—A definitive procedure for performing one or more specific operations or functions that does not produce a test result.

5.8 *Procedure*—Steps to perform, explain, or accomplish task. As used in this catalog, a procedure may be a practice, guide, or test method.

5.9 *Qualified*—An employee who has met the requirements for a specific position or task.

5.10 *Senior Person*—An employee with a Senior Proficiency qualification in a procedure. Procedure GN-4(P), "Standard Practice for Personnel Qualifications", reference 3.2, describes elements of training and evidence of proficiency.

5.11 *Shall*—In procedures, a required action. Synonymous with "must" and "will".

5.12 *Should*—In procedures, a recommendation.

5.13 *Test method*—A definitive procedure for the identification, measurement, and evaluation of one or more characteristics of a material, product, system, or service that produces a test result.

5.14 *Training Information System*–A central data base providing an electronic record of personnel training.

5.15 *Will*–In procedures, a required action. Synonymous with "must" and "shall".

6. Significance and Use

6.1 The catalog is intended to be a source of information that may be used with the minimum administrative burden that is consistent with control of activities. The procedures may be used as written or they may be modified by the method discussed in Section 8 "Changes to Procedures".

6.2 This practice is for use by any personnel preparing procedures for the GJO *Environmental Procedures Catalog*. From the standpoint of technical accuracy, this practice will ensure that procedures are complete and scientifically sound. From the standpoint of usability, the practice will ensure that procedures are uniform and will help the user find information easily and understand it quickly.

6.3 All new, revised, or adopted procedures in this catalog will adhere to this practice.

7. New Procedures

7.1 New procedures may be needed to support new work, changes in work scope, new technology or instruments, or improved methods. When the need for a procedure to be added to the catalog is known, the EPAC will review the suggested procedure to determine if it is appropriate for inclusion.

7.2 *Types of Procedures*—Three categories of procedures are defined for this catalog on the basis of ASTM guidelines. These categories are practices, guides, and test methods. Development of the text will be based on the determination of which of these three categories best describes the procedure being prepared. Other types of procedures defined in ASTM may be used, if more appropriate. See reference 3.1, pp. 19–22, for more information.

7.2.1 Examples of practices include selection, preparation, application, inspection, necessary precautions for use or disposal, installation, maintenance, and operation of testing apparatus. Examples of guides include reference lists, general considerations, and glossaries. The following list describes headings to be included in a practice or guide. See reference 3.1, pp. 20–21, for more detailed information on practices and guides.

Title (mandatory)
Scope (mandatory)
Hazard Analysis (mandatory)
Referenced Documents
Terminology
Summary of Practice (or Guide)
Significance and Use (mandatory)
Reagents (including materials or equipment)
Procedure
Report
Precision and Bias (for included tests and analyses)

Keywords (mandatory)
Annexes and Appendices

7.2.2 Examples of test methods include determination of fundamental properties of materials and a variety of field and laboratory analytical or measurement procedures. The following list describes headings to be included in a test method. See reference 3.1, pp. 1–10, for more detailed information on test methods.

Title (mandatory)
Introduction
Scope (mandatory)
Hazard Analysis (mandatory)
Referenced Documents
Terminology
Summary of Test Method
Significance and Use (mandatory)
Interferences
Apparatus (includes equipment)
Reagents and Materials
Sampling, Test Specimens, and Test Units
Preparation of Apparatus
Calibration and Standardization
Conditioning
Procedure (mandatory)
Calculation or Interpretation of Results
Report
Precision and Bias (mandatory)
Keywords (mandatory)
Annexes and Appendices

7.3 Procedures will adequately describe the work so that a qualified person could use the procedure to perform work. The procedure will describe responsibilities and interfaces, delineate the method and sequence, and provide a means of recording data when appropriate. Acceptance criteria will be identified when applicable.

7.3.1 Additional quality assurance concerns for procedures are available in Procedure GN–6(P), "Standard Practice for Quality Assurance", reference 3.2.

7.4 Each procedure shall contain a section titled "Hazard Analysis," that identifies each potential hazard inherent to performance of the procedure.

7.4.1 Each procedure shall identify the potential hazards on a Hazards Identification Chart (Figure 1) by marking those hazards with a "Y" in the "Y/N" column. Hazard evaluation should not include site-specific hazards such as heat stress or contamination; these hazards are addressed in site–specific Health and Safety Plans.

7.4.1.1 For each hazard, the need for controls and the level of risk involved in performing the procedure shall be evaluated. Each hazard and any action necessary to implement a control shall be specified as a separate paragraph in this section.

7.4.2 The completed Hazards Identification Chart will be included in the procedure review package. The chart should no be included as part of the procedure. The chart is intended to assist reviewers in independently evaluating the procedure.

7.4.3 If no hazards requiring controls are identified, the Hazard Analysis section should contain the following text: "No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project."

7.5 *Procedure Format*—The format of procedures will follow the *Form and Style for American Society for Testing and Materials (ASTM) Standards*, reference 3.1, as amended by this procedure. When preparing procedures, the modified decimal numbering system (see reference 3.1, pp. 23–24) will be used to number divisions in the text. The divisions are numbered to show subordination of items within a section (e.g., 1., 1.1, 1.1.1, and 1.1.1.1 show the order of subordination).

7.6 *Miscellaneous Points of Style*

7.6.1 *Units of Measure*—Consistent units of measure will be used throughout the procedure. Units of measure are always spelled out the first time they appear in the text and any time they are not preceded by a value.

7.6.2 *Uppercase Letters—**Do not*** use uppercase letters when writing text or numbered text headings (e.g., "5.5.9 *Uppercase Letters,"* not "5.5.9 UPPERCASE LETTERS"). Use of all uppercase letters is acceptable in trade names, equations, variables, etc.

7.7 Text should be provided to the coordinator of the catalog on disk or by e-mail. The disk should be accompanied by a printed copy of the

HAZARDS IDENTIFICATION CHART

Procedure No. LQ-17(T) Date 3/1/97 Performed By Joe Blow

The following hazards shall be considered. The list may not be complete. Add any other identified hazard to the list. On an attached page describe each identified hazard along with controls needed.

Potential Hazard	Y/N
Electrical Sources	
Capacitors	
Transformers	
Batteries	
Exposed Conductors	
Static Electricity	Y
Underground Utilities	
Other High Voltage	
Motion Sources	
Pulley Belt	
Gear	
Shears	
Sharp Edges	
Pinch Points	
Vehicles	
Mass in Motion	Y
Rotating Equipment	
Gravity-Mass Sources	
Personnel Falling	
Falling Object	
Lifting	Y
Tripping, Slipping	
Earthquake	
Pressure Sources	
Confined Gases	Y
Explosives	
Noise	
Chemical Reactions	
Stressed Mechanical System	
Chemical Sources	
Corrosive Materials	
Flammable Materials	Y
Toxic Materials	
Radioactive Materials	
Pathogenic Materials	
Oxygen Deficiency	
Carcinogenic Materials	

Potential Hazard	Y/N
Heat Sources	
Electrical	Y
Steam	
Flames	
Solar	
Friction	
Spontaneous Combustion	
Cold Sources	
Cryogenic Materials	
Ice, Snow, Wind, Rain	
Radiant Sources	
Intense Light	
Lasers	
Ultraviolet (UV)	
X-rays, Ionizing Radiation	
Infrared Sources	
Electron Beams	
Magnetic Fields	
RF Fields, Microwave, Radar	

Other Hazards

Noise hazards due to generator

Figure 1. Example of a Hazards Identification Chart

text and all figures or forms to be included in the procedure. The coordinator will ensure that the procedure is in the proper format, assign the procedure number, coordinate reviews, and assist in comment resolution.

7.8 *Procedure Numbering*—Procedures in this catalog will be assigned a number in the following format: XX–N(A)

where:

XX = GN (General and Administrative chapter)
SL (Solids chapter)
LQ (Liquids chapter)
GS (Gases chapter)
GP (Geophysical Measurements chapter)
RD (Radiological Measurements chapter)

N = The sequential number of the procedure within the chapter.

(A) = Type of procedure: Practice (P), Guide (G), or Test Method (T).

7.8.1 For example, General Considerations for the Sampling of Liquids is the first procedure in the Liquids chapter and is numbered LQ–1(G).

7.8.2 The procedure number is indicated on the upper right-hand corner of each odd-numbered page. (This position is reversed on even-numbered pages.)

7.9 *Procedure Date and Revision*—The date and revision number of the procedure are indicated immediately below the procedure number. The date will appear in month and year format with the revision number directly following. For example, 1/91 Rev. 0 was issued in January 1991 and is the initial version.

7.10 "GJO" will appear on the upper left-hand corner of each odd-numbered page. (This position is reversed on even-numbered pages.)

7.11 The catalog coordinator should be contacted for questions regarding new procedures.

8. Changes to Procedures

8.1 *Changes to Existing Catalog Procedures*—When changes to a procedure are required, the originator shall submit a hard copy and/or electronic copy of the proposed revision to the catalog coordinator. For questions, contact the catalog coordinator.

8.1.1 If only editorial changes are needed, and the changes do not affect the safety or the quality of work performed or data generated, the changes may be made without going through the formal reviews that are required for technical changes; however, the changes must be approved by the EPAC Chair. A procedure for which only editorial changes are implemented will be given a new revision number and a new date. When such a procedure is distributed, it should be accompanied by a statement that the changes are editorial only.

8.2 *Project-Specific Changes to Procedures*—Changes to a procedure might become necessary during project planning or during field operations. Records of review and approval for these changes will be included in the project records. These changes should be considered for incorporation in the *GJO Environmental Procedures Catalog* if the same changes are made repeatedly.

8.2.1 Procedures from this catalog that will be used on a specific project in planning documents should be identified in those documents. Modification of a catalog procedure made during planning for the project will be through an addendum that is documented on the Document Addition/Revision form and approved by the Project Manager.

8.2.2 Changes that are needed during field operations will be documented in the field log and on the Document Addition/Revision form. The documented changes and a copy of the procedure will be given to the Project Manager or designee for review and approval. The review must include a technical review by the original author or reviewers who have comparable technical knowledge. The approval will be documented on the Document Addition/Revision form and appended to the procedures that are used in the field.

8.2.3 The Project Manager is responsible for evaluating each revision of a catalog procedure included as part of the project documents to determine if the revised procedure should replace the version that is currently in use for that project.

8.3 *Adopting Industry-Recognized Procedures*— When possible, programs should use existing industry-recognized procedures with an addendum rather than write new procedures for the catalog. The addendum will be titled "Technical Comments on (industry procedure number and title)" and shall include references to the numbered sections in the existing procedure that are being modified. A separate Hazard Analysis section and, as appropriate, specific sources of required equipment or supplies and quality assurance requirements should be added to the addendum. Any added sections will be numbered sequentially starting with the number following the last section of the industry procedure.

8.3.1 Industry-recognized procedures from source documents published by the U.S. Environmental Protection Agency, ASTM, U.S. Department of the Interior, National Water Well Association, American Petroleum Institute, or other recognized organizations should be used, if possible. Pe mission from the sponsoring agency, such as ASTM may be required to produce and distribute the procedure.

9. Procedure Review, Publication, Approval, and Distribution

9.1 *Procedure Review*—Each new, revised, or adopted procedure in this catalog will be sent to qualified technical individuals and personnel from environmental, safety, and quality groups for review. Editorial changes, as described in Section 8.1.1 require review only by the EPAC Chair.

9.1.1 The catalog coordinator sends a copy of the procedure along with a Record of Review form (see Figure 2 for front page) and Hazards Identification Chart (for new procedures) to each reviewer. Comments must be resolved by the author and/or coordinator before submitting the procedure for publication.

9.2 *Publication of Procedures*—The catalog coordinator arranges for production of additions or changes to the catalog.

9.2.1 Release of each revision to the catalog will require issuing a new Table of Contents. The Table of Contents lists each procedure within a chapter and the current date and revision number.

9.2.2 Change bars indicate revised material in the procedures and Table of Contents.

9.3 *Procedure Approval*—A copy of the final procedure along with a completed Document Addition/Revision form (Figure 3) is submitted to the EPAC Chair for approval before the procedure is released and distributed. A record of the approval will be maintained by the catalog coordinator.

9.4 *Distribution of Procedures*—The catalog coordinator will distribute copies of the catalog to library locations on the distribution list.

10. Procedure Access

10.1 Procedures may be copied directly from the catalog and inserted into other documents, such as Sampling and Analysis Plans. Catalog procedures may be identified in the documents by reference only; however, it is recommended that they be physically attached to the documents.

11. Records

11.1 A historical hard copy of each version (revision) of each procedure will be maintained by the Manager, MACTEC-ERS Compliance Management, or designee. Records of review and comment resolution will be maintained for the current version of each procedure; such records of previous versions may be destroyed.

12. Keywords

12.1 ASTM, guide, hazard analysis, practice, procedure, review, and test method.

Record of Review

Due Date	Review No.	Project:	Type of Review	Page
02/24/97		EPAC	Comprehensive	1 of 1

Document Title and\or Number and Revision

RD-4(T), Rev., Standard Test Method for Radium-in-Soil Sample Analysis Using the Opposed Crystal System (OCS)

Author
Cathy Kelleher (Return to Kym Bevan)

Author's Organization	Author's Phone

Reviewers: Joe Blow

Reviewer's Organization	Reviewer's Phone
Quality Assurance	

Reviewers Recommendation

- ☐ Release Without Comment
- ☐ Consider Comments
- ☒ Resolve Comments and Reroute for Review

Joe Blow 3/1/97
Signature of Reviewer and Date

- ☐ Comments Have Been Addressed

Signature of Author and Date

- ☐ Comments Resolution Satisfactory
- ☐ Comments Resolution Unsatisfactory

Signature of Reviewer and Date

Item No.	Reviewer's Comments and Recommendation	Reqd. (Y/N)	Item No.	Author's Response (if required)	Author's Initials
1	Page 1, section 1.3, last sentence Change to "it has several easily recognizable peaks."	N			
2	Page 5, section 6.1.2.1, first sentence "Misaligned" is not defined. Add "see section 8.1" after "misaligned".	N			
3	Page 10, section 9.1.6 Change the section number from 9.1.1.6 to 9.1.6	Y			

GJPO 1696 (Test)
(1/92)

Figure 2. Example of a Record of Review

Environmental Procedures Catalog

Document Addition/Revision

Procedure Title RD-4(T)

Requester Joe Blow

Justification Procedure update.

Proposed Changes (list here or attach copies) See attached copy.

New Document

X Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned RD-4(T)

Manager, Compliance Management *Date*

Project-Specific Change for ______ *Project*

Reviewed by ______ *Technical Author or Senior Proficient Designee* *(date)* Approved by ______ *Manager or Designee* *(date)*

Effective Date ______

GJO 1787
2-97

Figure 3. Example of a Document Additional/Revision Form

Technical Comments on ASTM D 5283–92

Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation

Summary of ASTM D 5283-92

This practice addresses the planning and implementation of environmental data generation.

Additions Applicable to Operating Contractor and Its Subcontractors

Sections 1 through 7 and 9 apply to organization of technical projects for the Contractor. Section 8 relates to analytical chemistry laboratory activities.

The following sections shall be considered in conjunction with the current published version of this ASTM practice. The sections shall be interpreted in numerical order, using the published version as the base document for reference.

2. Referenced Documents

2.4 *GJO Construction Procedures Manual* (GJO 5).

2.5 *GJO Health and Safety Manual* (GJO 2).

2.6 *GJO Quality Assurance Manual* (GJO 1).

2.7 *MACTEC–ERS, Environmental Compliance Manual* (MAC–1001).

2.8 *MACTEC–ERS General Administrative Procedures Manual* (MAC–1000).

2.9 *Wastren Environmental Compliance Manual* (FOS 202).

2.10 *Wastren GJ Policy Manual*.

6. Project Specification

6.3.1.1 Project Plan—Several Contractor project planning documents should be consulted by Project and Program Managers. The Contractor's administrative policy and procedures manual describes the policies and responsibilities to be followed by Contractor personnel; the Contractor's environmental compliance manuals (MAC–1001, FOS 202) describe the responsibility of the Contractor to conduct all activities in an environmentally safe manner; and the *GJO Construction Procedures Manual* (GJO 5) describes the policies and responsibilities of the Contractor in the management operations. Other documents that should be consulted are the *GJO Health and Safety Manual* (GJO 2), which describes the Contractor's strict adherence to safety standards; and the GJO *Quality Assurance Manual* (GJO 1), which describes the Contractor's Quality Assurance Program. See Section 2 for these references.

10. Hazard Analysis

10.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

Standard Practice for Field Documentation Processes

1. Scope

1.1 This standard practice covers reproducibility, legibility, accuracy, completeness, protection, identification, and error correction of records. The practice describes the control, data entry, content, review, and storage of field documents such as logbooks, field notebooks, data sheets, and other records.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 MACTEC-ERS General Administrative Procedures Manual (MAC-1000), Section 3, "Records Management Procedure".

3.2 GJO *Quality Assurance Manual* (GJO 1) Criterion 4, "Documents and Records".

3.3 *Wastren-GJ* Policy Manual

3.4 U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste, Vol. II, Field Manual, Physical/Chemical Methods*, SW–846, Office of Solid Waste and Emergency Response, November 1986, 3rd Edition.

4. Terminology

4.1 Records–Information or data on a specific subject collected and preserved in writing or other permanent form that has been verified and authenticated as technically complete and correct. Records may but are not limited to include data sheets, logbooks, field notebooks, maps, drawings, photographs, and electronic data-recording media.

4.2 *Technical record books*–For purposes of this practice, technical record books will refer to logbooks and field notebooks. These books are to be bound and the pages consecutively numbered.

5. Significance and Use

5.1 This practice will be used to document results of tasks performed using the *GJO Environmental Procedures Catalog*, unless the project Work Plan provides an alternate practice.

5.2 This practice includes the use of technical record books for direct data entry or as journals referring to the location of associated supporting documents for activities.

5.3 Documentation of the results produced from performing tasks is necessary to provide adequate evidence of compliance with requirements, provide an adequate basis for design decisions, and document techniques and conditions of sample collection.

6. General Procedures for Records

6.1 All records produced from work performed according to procedures in the *GJO Environmental Procedures Catalog* must meet the following requirements:

6.1.1 Records must clearly describe the work performed. Enough detail must be provided to enable someone of equivalent skill and experience in the technology to repeat the work as originally performed.

6.1.2 Records must be clear, legible, and reproducible. Black ink is preferred. Reproducible photocopies of penciled documents are acceptable as records.

6.1.3 Errors will be corrected by lining through the incorrect entry with a single line, making the correction, and initialing and dating the correction. The erroneous information must not be obliterated or erased.

6.1.4 Records must specify the activity conducted, the program sponsor, and the method used, if applicable. The signature of the person who performed the work and the date it was performed must appear on each page of a record and on any attached sheets. (Initials are acceptable if an initials log identifies the person.)

6.1.5 For short-term tasks, the Work Plan will define the records to be maintained for each task conducted and the disposition of the records. The following are suggested records of a short-term task:

6.1.5.1 Operational check data.

6.1.5.2 Data sheets.

6.1.5.3 Technical record books.

6.1.5.4 Official correspondence.

6.1.5.5 Planning documents.

6.1.5.6 Electronically or magnetically stored data.

6.1.6 For ongoing programs, a Working Records File Index defines what records will be generated, how long they will be retained, and the disposition of the records (see References 3.1 and 3.3).

6.1.7 Records must be protected against damage, deterioration, and loss while in the field, during data review, and until they are submitted to a storage facility. Records must be isolated from any source of contamination.

6.1.8 An independent reviewer will review data sheets or data contained in technical record books, as well as electronic data collection and data entry, as described in Section 7.5.

6.1.9 All data will be reviewed before personnel leave a remote site. The review will ensure that no additional sampling or data acquisition is required before departure.

6.1.10 When the procedure specifies compilation of data sheets, the data must be legible and traceable to the activity, project, and method used. The person completing the data sheet will sign and date the sheet and ensure that applicable spaces are completed.

7. Procedures for Technical Record Books

7.1 Technical record books will be bound books with sequentially numbered pages. Each book will be given a unique identifier.

7.2 *Issue and Control of Technical Record Books*–A technical record book will be assigned to an activity or a person for use on a project. The technical record book will be transmitted to the Project Manager or designee upon completion. If a technical record book contains information on more than one activity or project, the technical record book will clearly identify the portion associated with each activity or project. Reproducible copies of applicable sections of these books may be submitted to the Project Manager or designee as records.

7.2.1 The Project Manager shall determine the following and make a written record of the decisions:

7.2.1.1 Who will issue technical record books.

7.2.1.2 The number of each technical record book and the person to whom the book is issued.

7.2.1.3 The expected location for each technical record book when not in use (building and room number).

7.2.1.4 The reviewer of each technical record book and the frequency of reviews.

7.2.1.5 Whether support organizations are to use technical record books dedicated to the project or whether they will be required to furnish copies of applicable pages from technical record books supporting several projects.

7.2.2 The person to whom a technical record book is issued shall take the following steps upon receipt of a new technical record book:

7.2.2.1 Review general information on maintenance of the technical record book.

7.2.2.2 Complete the information block (if any) on the first sheet inside the front cover.

7.2.2.3 Identify the technical record book by entering the project number and title and the applicable task or subtask numbers as appropriate.

7.2.2.4 Determine whether to reserve specific pages for a Table of Contents and for the names of people who make entries and who will review the technical record book.

7.2.2.5 The first entry in the book shall describe the work covered and, as appropriate, the name of the sponsor, the Work Order or Statement of Work number, and the objectives of the work.

7.2.2.6 Prepare and maintain a list of the printed name, written signature, and initials used by each person who is authorized to make entries, including review entries.

7.3 *Rules for Data Entry*

7.3.1 Pages shall be kept intact. No page is to be left completely blank or removed from the book.

7.3.2 Use pages consecutively. If a page has entries from more than 1 day, each entry shall be signed and dated. If a page or part of a page must be left blank, it must be ruled across, signed, and dated. If entries for a given subject are made on two or more pages that are not consecutive, each page must be cross referenced to the previous and following entries.

7.3.3 Record all data as required by procedures for the activity being performed. Enter all data directly in a technical record book when practical. If loose sheets, such as test data sheets, photocopies, or photographs must be added to a technical record book, proceed as follows:

7.3.3.1 Glue, tape, or staple each sheet or part of a sheet to the next blank page or blank space, according to the amount of space needed.

7.3.3.2 Enter on the page of the technical record book a description of the material that is attached, and enter on each attachment the technical record book number and page number. This information will allow identification of the attachment if it comes loose.

7.3.4 Describe or reference in the technical record book any other permanent written or visual records generated for the project and not readily available in the open literature or that cannot be directly inserted because of size or bulk (e.g., data sheets, computer printouts, films, or magnetic media). Any project records that are cited must be filed and controlled as records. Records that are readily available in the open literature need only be referenced. The purpose is to provide a clear, complete record of activities and supporting documents.

7.3.5 The last entry in a technical record book shall be either a statement that the work was concluded or a reference to a sequential technical record book.

7.4 *Content of Technical Record Books*–The following information may be entered in technical record books, as applicable:

7.4.1 Table of Contents, consisting of pages with continuing entries.

7.4.2 What work was done and how it was done, including such information as a description of the facility, test design, measuring and test equipment (by serial number), and a reference by number and title to any standard procedure used.

7.4.3 Instrument numbers or equipment used, if not specified in a referenced procedure.

7.4.4 Field checks or calibrations that are not documented elsewhere.

7.4.5 Identification of personnel and responsibilities or duties of each person.

7.4.6 Why the work was done, including any Statement of Work under which the work was done and with what objective.

7.4.7 What results were obtained. Observations made, the review of the results, and nonconformances and deficiency reports may be included.

7.4.8 Temperature, weather, humidity, wind speed and direction, or other environmental influences that might affect the results.

7.4.9 Documentation of variances from planned activities. A variance is considered to be a deviation from "shall", "must", or "will" statements of a procedure.

7.4.10 Location of the activity, including site and sample or test location.

7.4.11 Name and address of field contact.

7.4.12 Sampling entries:

7.4.12.1 Purpose of sampling.

7.4.12.2 Description of sampling point and sampling methodology.

7.4.12.3 Number of samples taken and volume.

7.4.12.4 Date and time of sample collection.
7.4.12.5 Sample destination (name of laboratory) and how transported (hand carried or name of carrier, such as United Parcel Service or Federal Express).

7.4.12.6 References such as maps or photographs of the sampling site.

7.4.13 Entries relating to waste:

7.4.13.1 Producer of waste and address, if different for that location.

7.4.13.2 Type of process (if known) that produced the waste.

7.4.13.3 Type of waste (e.g., sludge, wastewater).

7.4.13.4 Suspected composition and concentrations of waste.

7.4.14 Other appropriate entries such as calculations, problems encountered and actions taken to resolve them, or interfaces with agencies.

7.5 *Review of Technical Record Books*–An independent reviewer will review technical record books for content, accuracy, legibility, calculations, error correction, and reproducibility (see Reference 3.2).

7.5.1 A reviewer will review electronic data collection or data entry for correctness and accuracy by comparison of originals with printed data or by review of the graphic representation of the data.

7.5.2 The reviewer will check for completeness, validity of data, and traceability between each page and the items or activities to which it applies. The reviewer will take action to correct any deficiencies.

7.5.3 When the reviewer is satisfied that the recorded information is complete and correct, the reviewer will sign and date the technical record book and indicate the pages and supporting documents that were reviewed.

7.5.4 Written comments by a reviewer that are clearly identified as review comments will not require review by a second reviewer.

7.6 *Storage of Technical Record Books*–Technical record books shall be stored in fire-resistant metal file cabinets or otherwise protected from damage when not directly in use. Records shall not be left unprotected overnight or on holidays, vacations, or weekends (see Reference 3.2).

8. Keywords

8.1 Data sheets, documentation, field documentation, field notebooks, logbooks, records, and technical records books.

Standard Practice for Personnel Qualifications

1. Scope

The purpose of this practice is to describe the experience, training, testing, or other criteria, and documentation of the same, that qualifies Contractor personnel to perform the test methods, practices, guides, or other procedural tasks described in the *GJO Environmental Procedures Catalog* (GJO 6) (Section 3.2).

1.2 Information in this catalog will be used in conjunction with criteria in the *GJO Training Manual (GJO 4)*, that describes training requirements. Information related to safe working conditions and practices is in the *GJO Health and Safety Manual* (Section 3.4) and the *GJO Site Radiological Control Manual* (Section 3.6). Environmental compliance issues are addressed in the Contractor's environmental compliance manuals (Sections 3.3 and 3.9).

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 American Society for Testing and Materials (ASTM), *Form and Style for ASTM Standards*, 9th Edition, November 1994.

3.2 *GJO Environmental Procedures Catalog* (GJO 6).

3.3 *MACTEC–ERS Environmental Compliance Manual* (MAC–1001).

3.4 *GJO Health and Safety Manual* (GJO 2).

3.5 *MACTEC–ERS General Administrative Procedures Manual* (MAC–1000).

3.6 *GJO Site Radiological Control Manual* (GJO 3).

3.7 *GJO Training Manual* (GJO 4).

3.8 *GJO Quality Assurance Manual* (GJO 1).

3.9 *Wastren Environmental Compliance Manual* (FOS 202).

3.10 *Wastren–GJ Policy Manual*

4.0 Terminology

4.1 *Competent*—Demonstrated ability to perform a test or procedure and obtain results that are within the stated precision of that test or procedure.

4.2 *Environmental Procedures Advisory Council (EPAC)*—A combined Facility Operations and Support/Technical Assesitance and Remediation (FOS/TAR) group of professionals with expertise in particular areas who serve as advisors to address questions and problems relevant to the *GJO Environmental Procedures Catalog*.

4.3 Guide—A series of options or instructions that do not recommend a specific course of action (Section 3.1).

4.4 *Practice*—A definitive procedure for performing one or more specific operations or functions that do not produce a test result (Section 3.1).

4.5 *Procedure*—A document that specifies or describes the way an activity shall be performed. As used in this catalog, a procedure may be a test method, practice, or guide.

4.6 *Proficiency*—Competency in a given art, skill, or branch of learning.

4.7 *Qualification*—The characteristics or abilities gained through education, training, or experience as measured against established requirements, such as standards or tests, that enable an employee to perform a required function or task in a competent manner. In this catalog, qualification means achievement of Senior or Standard Proficiency.

4.8 *Senior Person*—An employee with a Senior Proficiency qualification in a procedure.

4.9 *Senior Proficiency*—A qualification that designates the highest proficiency in a procedure that is based on experience, education, certifications, and/or letters of recommendation from supervisors. EPAC grants the Senior Proficiency qualification.

4.10 *Standard Person*—An employee with a Standard Proficiency qualification in a procedure.

4.11 *Standard Proficiency*—A qualification that is based on a combination of classroom training, on-the-job training (OJT), testing, or experience for a particular procedure. Standard Proficiency is granted by a Senior Person in a specific procedure.

4.12 Test method—A definitive procedure for the identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product, system, or device that produces a test result (Section 3.1).

4.13 *Training*—To make proficient with specialized instruction and/or practice.

4.14 Training Information System–A centralized data base containing electronic records of personnel training.

5. Significance and Use

5.1 The *GJO Quality Assurance Manual*, Criterion 2, establishes requirements for personnel training and qualifications.

5.1.1 Senior and Standard Proficiency categories are qualifications established at the GJO that are granted only to persons performing procedures in the *GJO Environmental Procedures Catalog*. Generally, Senior Persons are the Contractor experts in that particular discipline and Standard Persons are the persons who most often perform the tasks independently in the field.

5.1.2 An electronic record of these qualifications will be maintained in the Training Information System by the Wastren Training organization, so that project and functional managers may identify personnel qualified to perform tasks.

6. Requirements

6.1 A comprehensive training program is required for all employees to prepare them for safe and efficient conduct of all work-related activities. Because the Contractor's work for DOE, the general training program must satisfy many Federal, State, and specific DOE requirements. Training is dependent on the employee's needs and is ultimately the responsibility of the employee's supervisor. Training requirements for the procedures in this catalog will depend upon the level of proficiency (Senior or Standard) and the type of procedure.

6.2 Senior Proficiency

6.2.1 Senior Proficiency may be granted to those professional (exempt) staff who demonstrate expertise in a given procedure. A combination of the following criteria will be used to determine Senior Proficiency; Step 6.2.1.1 and the resumé in Step 6.2.1.2 are required:

6.2.1.1 Recommendation for Senior Proficiency form (Figure 1), which includes the following:

6.2.1.1.1 A list of the procedures for which an individual wants to be granted Senior Proficiency.

6.2.1.1.2 Documentation that the procedures have been read.

6.2.1.1.3 The individual's signature.

6.2.1.1.4 The signature, usually accompanied by a written recommendation, from the applicant's supervisor.

6.2.1.2 Documentation of 5 years' experience in a relevant discipline by resumé, pertinent certifications or qualifications from previous classes, work experience, and/or education.

6.2.1.3 Individual was the author of the procedure.

6.2.2 The Recommendation for Senior Proficiency form is signed by the EPAC Chair as documentation of EPAC's approval of the recommendation. The signed form is maintained by the EPAC Training Coordinator. A letter is sent to the individual showing each procedure for which Senior Proficiency has been granted.

6.2.3 The Senior Person shall maintain proficiency through personal initiatives, such as relevant training classes, seminars, professional meetings, publications, and ongoing work. Documentation of these activities should be added to the Senior Person's qualification file maintained by the EPAC Training Coordinator.

Recommendation for Senior Proficiency

______________________________ has been recommended by a member of the Environmental Procedures Advisory Committee (EPAC) as a Senior Person in the procedures listed below:

List Procedures

A Senior Person fulfills the following criteria associated with the aforementioned procedures.

1. Can conduct classroom and/or on-the-job training in the procedures.
2. Can consult with appropriate personnel about logistical considerations and sample plans.
3. Can make revisions to a procedure or write a new procedure to replace the outdated version.
4. Can select and/or coordinate field teams that perform the procedures.
5. Can perform on-site monitoring and/or supervision of fieldwork for the procedures.
6. Can perform interpretation of data generated by conducting the procedures.
7. Can demonstrate five (5) years of relevant professional experience.

I certify that I agree with the foregoing stipulations and have read and understand the foregoing procedures.

______________________________ ____________________
Applicant's Signature *Date*

Written Recommendation from Applicant's Supervisor:

____
____
____
____
____

______________________________ ____________________
Supervisor's Signature *Date*

______________________________ ____________________
EPAC Chair's Signature *Date*

Figure 1. Recommendation for Senior Proficiency Form

Individuals granted Senior Proficiency will be reviewed by EPAC every 3 years using the process in step 6.2.1. The EPAC Chair will indicate the reapproval by signature and date, as prescribed in Step 6.2.2.

6.2.4 For a designated or specified procedure, a Senior Person shall be capable of

6.2.4.1 Conducting classroom and/or practical training in the procedure;

6.2.4.2 Consulting with appropriate personnel about logistical considerations and sample plans associated with the procedure;

6.2.4.3 Making revisions to the procedure or writing a new procedure to replace an out–dated version;

6.2.4.4 Selecting and/or coordinating field teams to perform the procedure;

6.2.4.5 Performing on-site monitoring and/or supervision of field work using the procedure; and

6.2.4.6 Performing interpretation of data generated as a result of the procedure.

6.2.5 A person who believes he or she should have Senior Proficiency in a particular procedure without first obtaining Standard Proficiency in the procedure may submit a written request to the EPAC Chair. This request shall name the procedure and shall be accompanied by documentation attesting to the individual's capability. This request and information will be presented for discussion and decision at the next convenient EPAC meeting.

6.3 *Standard Proficiency*

6.3.1 A Senior Person for a particular procedure may grant a Standard Proficiency qualification in that procedure using a Recommendation for Standard Proficiency form (Figure 2) with accompanying documentation. Application materials will be maintained in the individual's qualification file kept by the EPAC Training Coordinator. A combination of the following criteria will be used to determine Standard Proficiency; Steps 6.3.1.1 and 6.3.1.3 and the resumé in Step 6.3.1.4 are required:

6.3.1.1 Documentation that the procedure has been read.

6.3.1.2 Satisfactory demonstration of the tasks and documentation of satisfactory completion of any tests associated with the procedure.

6.3.1.3 Documentation of practical training by a Senior Person, which includes a checkoff list for the procedure. Figure 3 is an example of a form that may be used to demonstrate proficiency.

6.3.1.4 Documentation of experience in a relevant discipline by resumé, certifications, previous classes, work, and/or education.

6.3.2 The frequency of required training depends upon the amount of usage and complexity of the procedure. A Senior Person for a particular procedure shall dictate the frequency of training needed to maintain Standard Proficiency in that procedure. Standard Proficiency may be reinstated every 3 years by an extension submitted to the individual's qualification file, maintained by the EPAC Training Coordinator.

6.3.3 For a designated or specified procedure, a person with Standard Proficiency shall be capable of

6.3.3.1 Properly executing the procedure independently in the field;

6.3.3.2 Reading and understanding a Sampling and Analysis Plan or Work Plan that involves the procedure;

6.3.3.3 Coordinating and preparing equipment and logistical requirements to perform the procedure;

6.3.3.4 Obtaining necessary field blanks or performing other quality assurance/quality control requirements; and

6.3.3.5 Completing the required data sheets or notebooks and associated paperwork.

6.3.4 Prior to September 5, 1996 (contractor changeover) an individual who had competently demonstrated Standard Proficiency in a particular procedure through previous experience could be granted a Standard Proficiency qualification by EPAC. Recommendations for a person who had been performing a procedure competently in the past were submitted to EPAC with the following.

6.3.4.1 A list of procedures for which the applicant was being recommended, with the

Recommendation for Standard Proficiency

________________________________ has been recommended as a Standard Person in the procedures listed below:

List Procedures

A Standard Person fulfills the following criteria associated with the aforementioned procedures.

1. Has read the procedures.
2. Can execute procedures independently in the field.
3. Can read and understand a Sampling and Analysis Plan or Work Plan that involves the procedures.
4. Can coordinate and prepare equipment and logistical requirements to perform the procedures.
5. Can perform quality assurance/quality control requirements associated with this procedure.
6. Can complete the required data sheets or notebooks and associated paperwork.

I certify that I agree with the foregoing stipulations and have read and understand the foregoing procedures.

________________________________ ________________

Applicant's Signature *Date*

Written Recommendation from a Senior Person:

____

____

____

____

________________________________ ________________

Senior Person's Signature *Date*

Figure 2. Recommendation for Standard Proficiency Form

Performance Under Supervision, *Environmental Procedures Catalog* OJT

Demonstration of Proficiency

Procedure Title ______________________________

Steps/Operations	Date
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Approval:

______________________ has satisfactorily demonstrated proficiency in the above procedure.
Applicant's Name

______________________ ______________
Senior Person's Signature Date

______________________ ______________
Reinstatement Approval Date

Figure 3. Example of Form Used to Demonstrate Proficiency

signature of the supervisor and/or applicable Senior Person.

6.3.4.2 Documentation that the procedures had been read.

6.3.4.3 Documentation of experience in a relevant discipline by resumé, certifications, previous classes, work, and/or education.

6.4 An uncertified employee may assist a Senior or Standard Proficiency employee with a task as long as the uncertified employee remains under the direct supervision of the qualified employee. An unqualified employee assisting in an activity shall not complete any project record related to the activity.

7. Records Management

7.1 The EPAC Training Coordinator maintains personnel qualification records for the *GJO Environmental Procedures Catalog*. Records may include approved Recommendations for Senior and Standard Proficiency forms, class rosters, qualification checkoff sheets, examinations, resumés, memoranda, and other documents demonstrating training and/or proficiency in a discipline.

7.2 The EPAC Training Coordinator sends updates on personnel qualified as Senior or Standard Proficient to the Wastren Training organization, which maintains each employee's training record in the Training Information System data base.

7.3 Access to training records is available to the person listed on the record and his/her supervisor through the EPAC Training Coordinator or the contractor's training organization. Project Managers should contact appropriate supervisors for assignment of qualified personnel.

7.4 Records for personnel who leave the company will be maintained in the company archives for 75 years and then destroyed. The person's name will be removed from the data base upon notification of departure.

8. Appeals

8.1 Anyone who thinks he/she has been unfairly denied a Standard Proficiency qualification may appeal the decision of the Senior Person to EPAC. Written evidence clearly demonstrating unfair treatment must be presented to EPAC. The person requesting the action and the responsible Senior Person may be present during the EPAC meeting at which the appeal appears on the agenda, and may present their cases orally.

8.2 Similarly, anyone who thinks he/she has been unfairly denied Senior Proficiency may appear before EPAC and present his/her arguments.

9. Keywords

9.1 Guide, personnel, practice, procedure, proficiency, proficient, qualification, Senior Person, Senior Proficiency, Standard Person, Standard Proficiency, test method, and training.

GJO Environmental Procedures Catalog
Document Addition/Revision

Procedure Title: Standard Practice for Quality Assurance, GN-6(P), Rev. 3, 5/97

Requester: Farlie Pearl

Justification: The applicable QA requirements are incorporated into the text of the Operable Unit III Annual Monitoring Program in order to meet the project needs and apply QA requirements in a graded manner as prescribed by the Monticello Projects Quality Assurance Program Plan and directed in DOE Orders 5700.6C *Quality Assurance*.

Proposed Changes (list here or attach copies): Procedure GN-6(P) is applicable as the QA program for the Operable Unit III Annual Monitoring Program. See Attachment 1 which lists each program element and notes "no change", "modification", "clarification", or "correction" as applicable to the element.

☐ **New Document** ☐ **Change to Procedure** ☐ **Adopt Procedure**

Procedure Number Assigned ____________________

Procedure Title ____________________

Approval for Inclusion in Environmental Procedures Catalog:

____________________ ____________________
Manager, Compliance Management Date

Project Specific Change for Operable Unit III Annual Monitoring Program, MAC-MSGRAP 1.3.5, 9/97
Project

Effective Date October 1, 1997

Reviewed By Donna J. Riddle 9/29/97 **Approved By** Knista L. McCallum 9/29/97
Technical Author or Senior Proficient Designee Date Manager or Designee Date

GJO 1787
4/97

Attachment 1

GJO Environmental Procedures Catalog
Document Addition/Revision

Procedure Title: Standard Practice for Quality Assurance, GN-6(P), Rev. 3, 5/97

The following modifications and clarifications are made for the Operable Unit III Annual Monitoring activities:

6.1 *QA Program* - **Clarification:** The Quality Assurance Program will be implemented through the requirements established in the Annual Monitoring Plan and the attached or referenced procedures.

6.2 *QA Coordinator Responsibilities* - **Clarification:** A separate QA Plan is not required for this work. The Standard QA requirements are incorporated in the Operable Unit III Annual Monitoring Program (Document No. MAC-MSGRAP 1.3.5).

6.3 *Planning* - **No change**

6.4 *Work Readiness Review* - The following **Modification and Clarification** is made: A WWR is not required for this scope of work. Field personnel are responsible for assuring, through a pre-job review, that procedures, equipment, supplies, and logistics for conducting the sampling are adequate and ready for the job. The field "Lead" is responsible for assuring project documents are provided to the sampling team and that training requirements have been verified.

6.5 *Training* - **Clarification:** Personnel qualifications for Standard or Senior proficiency apply to the "Lead" field personnel only. Team members work under the direction of the "Lead".

6.6 *Procurement Control* - **Clarification:** These requirements apply to the purchase of sample containers. Analytical services will be performed by the DOE-GJO Analytical Laboratory. If analytical services are subcontracted, QA personnel will review the procurement documents.

6.7 *Procedure Requirements* - **No change**

6.8 *Calibration Control* - **No change**

6.9 *Field Documentation* - **No change**

6.10 *Sample Identification and Control* - **No change**

6.11 *QA Objective for Measurement Data* - **No change**

6.12 *Document Reviews* - **No change**

6.13 *Nonconformance Control* - **No change**

6.14 *Corrective Action* - **No change**

6.15 *Independent Assessments* - **No change**

Standard Practice for Quality Assurance

1. Scope

1.1 This practice applies to all activities that will be conducted in accordance with the procedures in this catalog. The *GJO Quality Assurance Manual* (GJO 1) is the basis for this standard practice. When a program-specific Quality Assurance Program Plan (QAPP) exists, the Work Plan will prescribe implementation of the site-specific requirements of the QAPP. Responsibility for the quality of work rests with those performing the work. Quality Assurance (QA) Groups support programs and projects by the assistance of a QA Coordinator and through monitoring and surveillance activities.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified for this practice. Site-specific controls are specified in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 Title 10, *U.S. Code of Federal Regulations*, Part 830, Section 120 (10 CFR 830.120), "Quality Assurance Requirements"

3.2 *Wastren Calibration and Control Program Manual* (FOS 213)

3.3 *GJO Environmental Procedures Catalog* (GJO 6)

Procedure GN–1(P), "Standard Practice for Preparing or Revising Procedures for the *GJO Environmental Procedures Catalog*"

Procedure GN–2(P), "Technical Comments on ASTM D 5283–92—Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation"

Procedure GN–3(P), "Standard Practice for Field Documentation Processes"

Procedure GN–4(P), "Standard Practice for Personnel Qualifications"

Procedure GN–8(P), "Standard Practice for Sample Labeling"

Procedure GN–9(P), "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples"

3.4 Contractor's Procurement Manual

3.5 *GJO Quality Assurance Manual* (GJO 1)

Criterion 1, "Quality Assurance Program"

Quality Assurance Instruction (QAI) 1.3, "Suspension of Activities"

Criterion 3, "Quality Improvement"

QAI 3.4, "Nonconformance Reporting, Disposition, and Closure"

QAI 3.5, "Corrective Action Request System"

4. Terminology

4.1 *Audit*—A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established instructions, procedures, drawings, or other applicable documents, and the effectiveness of implementation of requirements.

4.2 *Calibration*—Comparison of measurement equipment with reference standards of greater accuracy to detect, quantify, report, and reduce inaccuracies. Calibration may include adjustment or alignment, depending on the as-found condition of the equipment.

4.3 *Controls*—Documented administrative rules, orders, instructions, procedures, policies, practices, and designations of authority and responsibility.

4.4 *Corrective action*—Measures taken to remedy conditions adverse to quality and, where necessary, to prevent recurrence.

4.5 *Corrective Action Request (CAR)*—A document used to identify significant conditions adverse to quality, identify corrective action, and record verification of corrective action taken (Reference 3.5).

4.6 *Deviation*—A departure from specified requirements or procedures.

4.7 *Document*—Any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results. A document is not considered to be a record until it includes actual data, results, or information and is authenticated.

4.8 *Documentation*—A body or group of documents; the act of generating documents or assembling of a group of documents.

4.9 *Document control*—The act of ensuring that documents (and changes to documents) are reviewed for adequacy, approved by authorized personnel for release, and distributed to and used at locations where the activity is performed.

4.10 *Indoctrination and Training*—All of the actions necessary, such as classroom sessions, on-the-job training, or required reading, to ensure that personnel are properly trained to manage or perform activities that affect quality. Personnel must be familiar with and understand the purpose, scope, and implementation of the QA Program as it applies to their work.

4.11 *Interface*—Interaction between individuals, groups, or organizations.

4.12 *Measurement and Test Equipment (M&TE)*—Devices or systems used to calibrate, measure, gauge, test, or inspect in order to control or acquire data or verify conformance to specified requirements.

4.13 *Nonconformance*—A deficiency in a characteristic, procedure, or documentation that renders the quality of an item unacceptable or indeterminate. Examples of nonconformances include, but are not limited to, physical defects; test failures; incorrect or inadequate documentation; or deviations from prescribed processes, inspections, test procedures or other technical requirements.

4.14 *Nonconformance Report (NCR)*—The document used to report the identification and disposition of nonconformances (Reference 3.5).

4.15 *Planning document*—A document that specifies the work to be completed, sampling strategies, tests required, level of quality control (QC) applied, personnel assignment and responsibilities, and deliverables. Some projects may require Field Sampling and Analysis Plans or other specified planning documents.

4.16 *Procedure*—A document that specifies or describes the way an activity is to be performed. As used in this catalog, a procedure may be a test method, practice, or guide.

4.17 *Procurement document*—Purchase requisitions, purchase orders, subcontracts, specifications, or instructions formally approved and used to perform the procurement process. Procurement documents shall also define the requirements that must be met before items or services may be accepted by the contractor.

4.18 *Program plan*—A written description of the activities required for achievement of the goals or objectives of a program. The plan describes the strategy to follow and the major actions to take to achieve those objectives. The plan addresses program-related elements, including program interfaces, schedule, major milestones, budget, technical control, quality assurance, and program control.

4.19 *Quality Assurance*—All the planned and systematic actions necessary to provide adequate confidence that a facility, structure, system, or component will perform satisfactorily in service. The goal of QA is to ensure that these procedures and that the technical data are valid and retrievable. QA includes QC.

4.20 *Quality Assurance Coordinator*—A functional title for QA staff assigned to provide QA assistance in the management of activities and programs. The QA Coordinator assists in establishing the QA Program Plan and evaluating compliance with the Plan.

4.21 *Quality Assurance Program*—The system of activities associated with defining, implementing, and verifying compliance with the requirements for QA. The QA Program is described in the *GJO Quality Assurance Manual* (GJO 1).

4.22 *Quality Assurance Officer*—The Manager of the contractor organization to which QA staff are assigned. The Manager is independent of Program/Project assignment.

4.23 *Quality Assurance Program Plan*—A document that identifies the requirements judiciously selected from the overall QA Program, along with customer-imposed QA requirements, that are to be implemented on a particular program.

4.24 *Quality Control*—Verification that work or products meet requirements or specifications. Examples of QC methods are data reviews; use of spikes, duplicates, and blanks in analysis; and inspection of work in process.

4.25 *Record*—A document that furnishes evidence of the quality of items or activities and has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data-recording media.

4.26 *Sampling and Analysis Plan*—A plan that defines sampling strategies, data-quality objectives, traceability, QC, and records requirements.

4.27 *Shall*—Denotes a mandatory requirement or action. "Must" is synonymous with "shall" and "will".

4.28 *Signature (or signed)*—A person's name, written by that person, including given names or initials and full last name.

4.29 *Stop Work*—To discontinue all or any of the activities related to safety or the fulfillment of contract obligations.

4.30 *Stop Work Order*—A formal request by an oversight organization member to suspend activities when other measures to obtain corrective action have failed, and risk resulting from loss, damage, or continued noncompliance is high (Reference 3.5).

4.31 *Surveillance*—The act of monitoring or observing to determine whether an item or activity conforms to specified requirements.

4.32 *Technical review*—A formally documented review of technical material performed by individuals independent of those responsible for the work but who may be members of the organization that performed the work.

4.33 *Traceability*—The capacity for tracing the history, application, or location of an item or sample by means of documentation or physical identification.

4.34 *Variance*—A deviation from "must," "shall," or "will" statements in a procedure.

5. Significance and Use

5.1 The GJO Quality Assurance Program is defined by the *GJO Quality Assurance Manual* (GJO 1), which is based on 10 CFR 830.120, "Quality Assurance Requirements". The *GJO Quality Assurance Manual* (GJO 1) specifies QA requirements which are graded into "Standard" and "Q" level requirements. The GJO *Environmental Procedures Catalog* (GJO 6) implements the "Standard" level requirements unless the planning document or the procedure specifies "Q" level requirements.

5.2 This practice defines the QA Program elements that are routine to the use of test methods, guides, and practices. This practice should be used along with the planning documents that may specify additional program-specific requirements.

6. Procedure

6.1 The Quality Assurance Program will be implemented through the *GJO Quality Assurance Manual* (GJO 1), QAPPs, planning documents, and the instructions in this catalog.

6.2 QA Coordinators are assigned to support program or project activities. The QA Coordinator will assist the Program or Project Manager in evaluating the need for and preparing a QAPP to grade the level of quality needed for the program. The QA Coordinator will also review planning documents to verify that any QA requirements for the program are included.

6.3 The planning document will describe and plan field activities, as described in Procedure GN–2(P), "Technical Comments on ASTM D 5283.92—Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation." The preparer of the planning document needs to use the applicable program QAPP requirements as an input to the Work Plan.

6.3.1 The planning document will designate the organization(s) responsible for performing particular tasks and the interfaces between work teams, support organizations, and program personnel; and will specify responsibilities and authorities of team members. The planning document will specify how the quality of work will be determined and by whom.

6.4 A Work Readiness Review will be performed prior to the start of work if required by the QAPP.

6.5 Personnel performing work will be trained as defined in Procedure GN–4(P) "Standard Practice for Personnel Qualifications." Only trained personnel will be assigned to conduct work using the *GJO Environmental Procedures Catalog* (GJO 6). A trained person can supervise the assistance of personnel who have not received training on a particular procedure. The trained person will record any data and will be responsible for the results of the activity. The Project Manager or designee will verify personnel qualifications and training prior to work assignment.

6.6 The purchase of items or services will be accomplished as specified in the contractor's procurement manual. As appropriate, procurement documents will specify the scope of work, technical requirements (reference to existing codes or standards is recommended where possible), rights of access, and documents to be submitted.

6.6.1 QA review of procurement documents may be considered when the items to be purchased must meet quality requirements or other standards. Examples of procurements where QA review is beneficial are subcontracted services, instrument calibration, and equipment fabrication.

6.7 Work will be controlled by instructions, procedures, and drawings. Procedures will be prepared, reviewed, approved, and issued prior to beginning the work. The procedures will be controlled to ensure that personnel have current and correct copies of the procedures, instructions, and drawings. Procedure GN–1(P), "Standard Practice for Preparing or Revising Procedurs from the *GJO Environmenal Procedures Catalog*" will be used for procedures in this catalog.

6.7.1 Should modification to a procedure be needed for a particular task, the revised procedure must be documented as described in Procedure GN–1(P), "Standard Practice for Preparing or Revising Procedures for the *GJO Environmental Procedures Catalog."*

6.7.2 Variations from procedures in the field will be documented on the data sheet or field notebook. The variation will be evaluated for its effect during data review.

6.8 The *Wastren Calibration and Control Program Manual* (FOS 213) applies to any activity that requires calibrated M&TE. The GJO Electronics Laboratory will provide maintenance and calibration services upon request.

6.8.1 Personnel using instruments that affect or evaluate the quality of an activity are responsible for ensuring that the instrument is controlled and that accuracy is documented. The instruments must have a label that documents the calibration status. If labeling is not feasible, the records must show current calibration.

6.8.2 Instruments will be checked for proper functioning daily before use. The documentation must show that the instrument is functioning within the established parameters. Verification of a current calibration sticker will be performed during the operational check.

6.9 All project work activities will be documented in permanent form. Records must be legible, identifiable, reproducible, signed, and dated. Records will be protected from loss or damage by reasonable handling of documents. Corrections will be made by crossing through the entry with a single line, entering the correction, initialing, and dating. Refer to Procedure GN–3(P), "Standard Practice for Field Documentation Processes" for record preparation, protection, and disposition.

6.10 Sample traceability will be maintained through use of Procedure GN–8(P), "Standard Practice for Sample Labeling" and Procedure GN–9(P), "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples."

6.11 The planning document will specify QA objectives for measurement data, if applicable (such as accuracy, precision, completeness, representativeness, and comparability). The plan will detail how the objectives will be satisfied.

6.12 The following types of document reviews will be conducted:

6.12.1 The individual performing the test or practice will review the data to verify correctness. When data are collected electronically, the individual will review the printed representation.

6.12.2 A person other than the person recording the data will review individual data sheets or records for reasonableness and completeness. The reviewer will document the review on the data sheet by a legible signature and date.

6.12.3 Formal and informal reports will be reviewed as described in the contractor's administrative policies and procedures.

6.12.4 Reviews of procedures in the *GJO Environmental Procedures Catalog* (GJO 6) will be conducted as described in Procedure GN–1(P), "Standard Practice for Preparing or Revising Procedures for the *GJO Environmental Procedures Catalog.*" Contractor procedure reviews will be conducted and documented as prescribed by the contractor's administrative policies and procedures.

6.12.5 Procurement documents will be reviewed for inclusion of technical requirements, deliverables, scope of work, quality requirements, and rights of access (when appropriate).

6.12.6 Data-quality reviews will assess whether the data quality objectives, as a whole, have been achieved.

6.13 Items or activities that do not conform to written requirements will be identified, controlled, and corrected. Nonconformances are deficiencies in characteristic, procedure, or documentation that render the quality of an item unacceptable or indeterminate. Nonconforming items or data that have been transmitted to other organizations must be reported and evaluated as directed in QAI 3.4 of the *GJO Quality Assurance Manual* (GJO 1). The person who identifies a nonconformance will initiate a report using the Nonconformance Report (Form 1594). The QA Coordinator will be notified of and assist in the administration of the Nonconformance Report.

6.14 All work will be conducted in accordance with appropriate quality standards. Those with the responsibility for the work have primary responsibility for achieving quality and taking corrective actions as needed to maintain the quality of work.

6.14.1 When conditions adverse to quality have been identified through Nonconformance Reports, audits, or surveillance and corrective action has been ineffective, the contractor's QA Officer may issue a CAR as directed in QAI 3.5 of the *GJO Quality Assurance Manual* (GJO 1). Managers of organizations receiving a CAR are responsible for evaluating the condition, proposing corrective actions, and completing corrective actions in a timely manner. The QA Officer will evaluate proposed corrective action or recovery by the responsible organization and close the CAR as appropriate. At the direction of the QA Officer, the QA Coordinator will verify implementation of the corrective action.

6.14.2 When significantly adverse conditions have been identified and management response has not been initiated or is ineffective, suspension of activities may be initiated by the - contractor's QA Officer through a Stop Work Order as directed in QAI 1.3 of the *GJO Quality Assurance Manual* (GJO 1). The QA Officer will evaluate proposed corrective action or recovery by the responsible organization and lift the Stop Work Order as appropriate. At the direction of the QA Officer, the QA Coordinator will verify implementation of the corrective action.

6.15 The contractor's QA Group will verify implementation of the QA Program by conducting audits and surveillance of programs and activities of contractor organizations. Qualified personnel will conduct audit activities using the requirements in the *GJO Quality Assurance Manual* (GJO 1) and internal QA procedures.

7.0 Keywords

7.1 See Section 4., "Terminology."

Standard Practice for Sample Labeling

1. Scope

1.1 This procedure addresses labeling requirements and recommended practices for labeling samples that are collected in the field and intended for analysis at a later time. The materials sampled may include, but are not limited to, solids such as soils and cores, liquids and sludges, and gases.

1.1.1 This procedure does not address labeling practices for any in situ measurements.

1.2 This procedure is intended for use with a variety of sample types, including grab samples, composite samples, duplicate samples, and split samples.

1.3 All samples collected by Contractor personnel shall have a sample label and a Contractor-generated sample number.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 GJO, *Environmental Procedures Catalog* (GJO 6)

GN-3(P), "Standard Practice for Field Documentation Processes"

GN-9(P), "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples"

4. Terminology

4.1 *Chain-of-Sample-Custody Form*—A form used to document sample custody and receipt. It also may contain other information, such as the sample analyses required and traceability.

4.2 *Field*—Any place where the material for analyses or testing is collected.

4.3 *Duplicate samples*—More than one sample collected from the same source location, but placed in separate containers. Also called multiple samples.

4.4 *In situ*—In place; not removed from the point of original deposition.

4.5 *Sample* (n)—A portion of material collected from a larger mass that represents the characteristics of that mass.

4.6 *Sample* (v)—To select and collect a sample.

4.7 *Sample label*—The documentation attached to the sample or sample container and marked with required information about the sample. An example is shown in Figure 1.

Grand Junction Office
2597 B 3/4 Road
Grand Junction, CO 81503
970/248–6000

Sample No. ______________ Date ______________

Sampler ______________ Time ______________

Project Site ______________ Location ______________

Sample Type ______________

Comments ______________

____

Figure 1. Example of Sample Label

4.8 *Sample log*—A document that lists all samples collected during a field visit or visits. A Chain-of-Sample-Custody form or sample ticket book are examples of sample logs.

4.9 *Sample number*—The unique identification number assigned by the Contractor to each sample and attached to, or written on, the sample label or sample container. The sample number will normally consist of three alpha and three numeric characters and will have both eye-readable and bar-code portions (Figure 2).

NDK451

Figure 2. Example of a Sample Number

4.10 *Sample Plant*—the facility at the Grand Junction Office where samples are prepared for analysis.

4.11 *Sample ticket book*—A soft-bound book consisting of 25 sample numbers, one number per page. Each page is backed by two duplicating no-carbon required (NCR) sheets. For each sample number, a separate page containing 27 duplicate numbers is included. The duplicate number lablels are self-adhesive.

4.12 *Split sample*—A sample that has been subdivided into two or more parts, each representative of the original sample.

5. Significance and Use

5.1 All Contractor personnel shall use this procedure for sample identification unless an approved alternate procedure is included or referenced in the official project records. Alternate procedures shall include the minimum information identified in Section 8.4.

6. Materials

6.1 Preprinted Contractor sample labels with adhesive backing.

6.2 Preprinted sample numbers with adhesive backing or a sample ticket book (GJPO 1854) with preprinted adhesive-backed sample numbers.

6.3 Ballpoint pen with reproducible, water-proof ink.

6.4 Clear plastic tape (normally 2 inches wide).

6.5 Sample log.

7. Procedure for Obtaining Contractor Sample Numbers

7.1 Bar-coded sample numbers are printed by the Wastren Information Management group. To avoid duplication of numbers, the computer software that produces the numbers will prompt the user with the starting number for the new series to be printed.

7.2 The sample numbers are printed on a roll to be attached to sample labels to be bound into the sample ticket books.

7.3 Sample numbers and labels are obtained from the Field Services administrative staff. If appropriate, obtain sample ticket books from the Contractor's Sample Plant.

7.4 The issuing organization will maintain a log of the sample numbers or ticket books issued, the requester's name, and the date of issue.

7.5 The issuing organization shall obtain a new stock of sample numbers as needed from Wastren's Information Management group.

8. Procedure for Using Sample Labels

8.1 Complete the sample label before or after attachment to the sample container. If labels are not available, write the required information directly onto the sample or sample container. Never write directly on a sample that is to be chemically analyzed.

8.2 Use waterproof, reproducible ink to complete the required label information.

8.3 Normally, the sampler will complete the entire label. If some of the requested information is not relevant, write "NA" for "not applicable" in that space.

8.4 The minimum information required on the sample label shall include

8.4.1 *Sample number*.

8.4.2 *Date*—The date the sample was collected.

8.4.3 *Sampler identification*—The name or initials of the person who collected the sample.

8.4.4 *Project site*—The area or property defined in project documents containing one or more sample locations. The property may be identified by a number.

8.4.5 *Sample location*—The location at which the sample was collected. Examples of sample locations include well numbers, grid locations, or surveyed coordinates.

8.5 Additional information that may be appropriate on the label includes

8.5.1 *Time*—The time at which the sample was collected.

8.5.2 *Sample type (matrix)*—One or more terms that describe the type of sample. This description may cover sample material such as soil, water, sludge, air, or core. It may also include the type of sample, such as composite, grab, or wipe.

8.6 Attach the preprinted sample number to the sample label. If the preprinted number is illegible or does not adhere to the label, the sampler may write the sample number on the sample, sample label, or sample container. The sampler also may write the number on tape and attach it to the sample.

8.7 Maintain a record of sample numbers and other pertinent information on a sample log. See Procedure GN-3(P), "Standard Practice for Field Documentation Processes" and Procedure GN-9(P), "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples", reference 3.1.

8.8 When needed, protect the completed sample labels from moisture and abrasion by placing a piece of clear plastic tape over the label.

9. Procedure for Using Sample Ticket Books

9.1 Sample ticket books contain preprinted numbers for labeling duplicate or split samples. A copy of a page from a sample ticket book (GJPO 1854) is shown in Figure 3.

9.2 If duplicate samples are taken at the same location or if split samples are made in the field, the sampler shall identify each sample by removing an adhesive-backed sample number from the book and attaching it to the sample label or container. The sample number shall be identical for each sample in the entire group of duplicates or splits.

9.3 Duplicate samples or split samples each may be assigned a unique sample number for purposes of documenting the precision of the sampling and analysis process. These samples are commonly referred to as "blind duplicates" or "field duplicates."

9.4 The information required on the sample ticket is summarized on the inside flap cover of the ticket book, as shown in Figure 4. When completing the ticket, the cardboard cover should be inserted after the pink page of the current ticket to prevent copying information onto the next ticket. A ballpoint pen should be used with sufficient pressure to ensure duplication onto all copies of the NCR sheets.

9.5 Normally, the white copy of the ticket is retained by the project manager, the canary copy is forwarded to the Sample Plant or analytical laboratory with the samples, and the pink copy remains in the ticket book. This distribution may vary depending upon the needs of the project.

10. Keywords

10.1 Label, sample, sample labeling, sample log, sample number, and ticket book.

NBB 651

Project GJ-12345

Site NA Location 323145

Date 1-28-94 Time 11:02 am Matrix Soil

Interval 0-6" Sampler CRK

Comments Next to underground storage tank fill spout.

Analyte(s)	Container Type	Number Collected	Filtered	Preservative
VOC	500 ml WM	1	NA	NA
Metals	1000 ml WM	1	NA	NA

CRK

GJPO 1854 7/92 White copy to Project Manager; canary to laboratory; pink remains in ticket [illegible]

Figure 3. Example of a Sample Ticket GJPO 1854

Required Information

Project:	Name of Project or Project Number: "GJ-12345"
Site:	Site location: "Landfill 3," "Unit 6"
Location:	Exact location of sample such as borehole number, monitor well number, or distance to permanent landmarks: "MW-018"
Date:	Date sample was collected.
Time:	Time sample was collected: "1420" or "2:20 p.m."
Interval	Beginning and ending depth interval of sample or time duration of sample: "2 feet to 3.8 feet," or "0800 to 1622" - dependent on sample type.
Matrix:	Type of sample: soil, water, air, product, tissue, etc.
Sampler:	Name(s)/initials of sampling personnel. Initials should be listed in project file for identification.

Optional Information

Project documentation may replace optional information to avoid unnecessary writing in the field. For example, a Sampling Plan may state "all VOC samples will be collected in 40 mL glass vials" thus avoiding the need to write this for each sample. If all filtered samples use a 40 micron filter, simply put a "Y" in the filtered field. Only variances from the Sampling Plan would need to be noted on the ticket. Information duplicated on many samples may be completed on the first ticket of the series and referred to subsequently: "Same as PNN 230" or "PNN 230."

Comments:	Area weather conditions, radiation levels, composite sample/grab sample, reason for sample, additional location information, or any factors that may affect analysis. Brief location maps with a scale and north indicator are useful.
Analyte:	Type of analysis to be performed: "KUT," "VOC's," "Metals," "Asbestos."
Type/Size:	Describe type of container: Glass, HDPE, Amber, "LDPE/500 mL," "1L NM Glass," "WMG/250 mL."

NM	Narrow Mouth	A	Amber Glass or Plastic
WM	Wide Mouth	G	Glass
HDPE	High-Density Polyethylene	P	Plastic
LDPE	Low-Density Polyethylene		

Number Collected:	Number of containers of each analyte.
Filtered:	Was sample filtered/size: Y/ "0.45 micron fiber."
Preservative:	Cool, HCL, HNO_3, Frozen, etc.
Completion of Sample Label:	Complete sample label as required. Remove Bar Code from ticket book and cover the "Sample Number" area on the sample label.

Figure 4. Example of a Sample Ticket (Back Cover of GJPO 1854)

Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples

1. Scope

1.1 This procedure describes the documentation required for tracing sample custody and the requirements for maintaining physical security of samples.

1.2 Control, storage, and disposal of samples should be addressed in the Work Plan for a particular project.

2. Hazard Analysis

2.1 No hazards requiring controls have been identified. Site-specific controls are available in the Health and Safety Plan for a particular project.

3. Referenced Documents

3.1 *GJO Environmental Procedures Catalog* (GJO 6):

GN–8(P), "Standard Practice for Sample Labeling".

4. Terminology

4.1 *Chain-of-sample-custody record*—A form such as the Chain of Sample Custody (GJPO 1512), or equivalent, used to document sample custody and receipt. GJPO 1512, Chain of Sample Custody, is a four-part no-carbon-required (NCR) form available as a Contractor Stores issue item (Figure 1).

4.2 *Custody*—To maintain a sample in sight, immediate possession, or locked under one's personal control.

4.3 *Custody seals or tags*—Adhesive-backed strips, or metal or plastic tags, fastened to the sample container or the shipping container in such a way as to demonstrate that no tampering with the sample has occurred. Custody seals also may be manufactured in the field by using paper strips and clear plastic tape.

4.4 *Duplicate samples*—More than one sample collected from the same source location but placed in separate containers. Also called multiple samples.

4.5 *Physical security*—Synonymous with custody but emphasizes the measures taken to prevent tampering with the samples or sampling process.

4.6 *Sample* (n)—A portion of material collected from a larger mass.

4.7 *Sample* (v)—To select and collect a sample.

4.8 *Sample number*—The unique identification number assigned by the Contractor to each sample and attached to, or written on, the sample label or sample container. The sample number will normally consist of three alpha and three numeric characters and will have both eye-readable and bar-code portions. See Procedure GN–8(P), "Standard Practice for Sample Labeling", Section 3.1, on how to obtain sample numbers.

4.9 *Split sample*—A sample that has been subdivided into two or more parts, each part representative of the original sample.

5. Significance and Use

5.1 All Contractor personnel shall use this procedure for chain-of-sample-custody control and physical security unless an approved alternate procedure is included or referenced in the official project records.

5.2 Projects that do not require sample custody documentation may use other types of sample logs for documenting sample information.

6. Materials

6.1 Chain of Sample Custody form (GJPO 1512) or equivalent.

6.2 Ballpoint pen with waterproof, reproducible ink.

Chain of Sample Custody

2597 B-3/4 Road
Grand Junction, Colorado 81502-5504
Telephone (303) 248-6000

1. Page____ of____

2. Date__________

3. Project Name ____________________

4. Site Location ____________________

5. Sampler *(print name)* ____________________

6. Sample No.	7. Date	8. Time	9. Sample Location	10. Sample Matrix	11. Containers						12. Remarks	13. Condition Received

14. Relinquished by *(signature)*	Date	Time	Relinquished by *(signature)*	Date	Time	Relinquished by *(signature)*	Date	Time
Received by *(signature)*	Date	Time	Received by *(signature)*	Date	Time	Received by *(signature)*	Date	Time

15. Method of Shipment	16. Laboratory/Destination	17. Airbill or Receipt Number

18. For Contract Laboratories Only—Receiver to sign, date, and return form by mail or with analytical data package

Company Name ________________ Received by ________________ Date ________

Preparation instructions on back of form.

Distribution: Original accompanies shipment, copies to relinquisher.

Figure 1. Chain of Sample Custody Form (GJPO 1512)

6.3 Custody seals or tags.

6.4 Clear plastic tape (normally 2 inches wide).

6.5 Padlocks, receptacles, containers, and/or enclosures as appropriate to provide physical security of the samples.

7. Chain-of-Sample-Custody Procedure

7.1 The sampler shall complete the chain-of-sample-custody record during or after sample collection. Use the current version of GJPO 1512 unless a project specifies a different form or specifies that no chain-of-sample-custody is required.

7.2 Use waterproof, reproducible ink to complete the form.

7.3 The initiator of the form is responsible for legibility of all entries other than signatures.

7.4 General instructions for completing GJPO 1512 are printed on the back of the form (Figure 2). The following items provide additional information to the instructions.

7.4.1 The preservation method may be specified in the remarks column.

7.4.2 *Condition Received*—Examples of conditions to note could include broken container, lid off, leaking fluid, etc.

7.4.3 *Relinquished by/Received by*—When the samples are physically transferred from one person to another, or from a person to a shipper, the relinquisher and receiver shall sign the appropriate block, with the date and time of sample transfer. The relinquishers, by signing, verify that the samples have been within their custody

7.4.3.1 It is each signatory's responsibility to write the signature legibly.

7.4.3.2 The relinquisher retains a copy of the form.

7.4.3.3 Non-Contractor employees are not required to sign the form (e.g., employees of shipping companies).

7.5 The following is the minimum information required on the form to ensure sample identification:

7.5.1 Date chain-of-sample-custody form was prepared;

7.5.2 Project name;

7.5.3 Sampler's printed name; and

7.5.4 Sample number.

7.6 Complete all information blocks or label the blocks "NA" for "not applicable." Line through unused portions of items 6 through 13 with a single line, and initial and date the line (Figure 3).

7.7 When samples will be transported by a non-Contractor shipper, use custody seals or tags to seal the individual sample containers or the inner or outer shipping carton.

7.7.1 When seals are applied to the sample container, they must not obscure the information on the sample label.

7.7.2 Securely wrap or fasten shipping containers prior to application of the custody seals. The seals are inherently fragile and will not withstand pressure from an inadequately packaged container. Seal all possible access flaps or lids of the shipping container.

7.7.3 Enter the date the samples are sealed and sign the custody seals or tags (see Figure 4). Clear plastic tape may be applied over the seals for protection.

CUSTODY SEAL

Date__________________________

Signature_______________________

Figure 4. Example of Custody Seal

7.8 The original chain-of-sample-custody record shall accompany the samples until they are received by the laboratory.

7.9 Unless otherwise specified by the project, the chain-of-sample-custody record shall be maintained as part of the project records.

Chain of Sample Custody

1. **Page______of ______:** Indicates sequence and total number of pages.
2. **Date:** Date the chain-of-custody record was prepared.
3. **Project Name:** The project name or title.
4. **Site Location:** The location of the project site.
5. **Sampler:** The printed name of the person who collected the samples.
6. **Sample No.:** The unique three-letter, three-digit number generated by Geotech.
7. **Date:** Date the sample was collected.
8. **Time:** The time the sample was collected.
9. **Sample Location:** The location at which the sample was taken; e.g., well number, grid location, or survey coordinate.
10. **Sample Matrix:** The sample matrix, e.g., soil, sludge, water, air, or filter.
11. **Container:** The type of container; e.g., write 40-ml glass in the slanted column. Write the number of containers of a given type on the corresponding horizontal line.
12. **Remarks:** Any remarks, as appropriate; preservation method required, e.g., acidified < 2 pH.
13. **Condition Received:** For use by laboratory personnel, to note any damage to sample or container.
14. **Relinquished by/Received by:** Signatures of relinquishers and receivers, with date and time of sample transfer.
15. **Method of Shipment:** The method of shipment, e.g., Federal Express, bus line, etc.
16. **Laboratory/Destination:** The place the samples were shipped for analysis, storage, or other purposes.
17. **Airbill or Receipt Number:** For use with airbills or receipts from contract shippers.
18. **For Use by Contract Laboratories Only:** For use by laboratories other than the Geotech Analytical Laboratory of the Grand Junction Projects Office (GJPO). Receiver to sign, date, and return this form to Geotech by mail or with analytical data package.

General: The purpose of this form is to document sample custody and receipt. Geotech/GJPO assumes no responsibility for samples not in the custody of Geotech personnel.

The users of this form are responsible for completing the form by using a waterproof, reproducible ink.

The users of this form are responsible for legibility of all entries.

All information blocks must be completed or marked as "NA" for "Not Applicable." Unused portions of the form must be lined out with a single line, initialed, and dated.

Figure 2. Instructions for Completing Chain-of-Sample-Custody Form (Reverse Side of GJPO 1512)

Chain of Sample Custody

1. Page 1 of 1

2. Date 3/5/97

2597 B-3/4 Road
Grand Junction, Colorado 81502-5504
Telephone (303) 248-6000

3. Project Name OU I

4. Site Location Monticello, Ut

5. Sampler *(print name)* Sam Sampler

6. Sample No.	7. Date	8. Time	9. Sample Location	10. Sample Matrix	11. Containers: 1L plastic	125 ml plastic	0.5L glass	40ml glass		12. Remarks	13. Condition Received
NAA 001	3/5/97	1:00p	Well 5A	Water	3					Ra-226, pH<2 HNO_3	ok
						1				metals, pH<2 HNO_3 Unfiltered	
							3			PCB, Unfiltered, Cool	
								1		BOD, Cool	

TLB 3/5/97

14. Relinquished by *(signature)*	Date	Time	Relinquished by *(signature)*	Date	Time	Relinquished by *(signature)*	Date	Time
Sam Sampler	3/5/97	1:30p						
Received by *(signature)*	**Date**	**Time**	**Received by** *(signature)*	**Date**	**Time**	**Received by** *(signature)*	**Date**	**Time**
Logan Receipt	3/5/97	1:30p						

15. Method of Shipment

16. Laboratory/Destination

17. Airbill or Receipt Number

18. For Contract Laboratories Only—Receiver to sign, date, and return form by mail or with analytical data package

Company Name ______ Received by ______ Date ______

GJPO 1512
Rev 11/92

Preparation instructions on back of form.

Distribution: Original accompanies shipment, copies to relinquisher.

Figure 3. Example of Completed Chain-of-Sample-Custody Form

8. Physical Security of Samples and Sampling Process

8.1 The sampler must maintain physical security of the samples, sampling process, and equipment by physical possession, visual contact, or seals or locks to prevent tampering. Because the procedures for physical security are unique to each sampling situation, only guidelines can be given.

8.1.1 Lock the sampling device when unattended. For example, when using an unattended autosampler to collect samples for a period of time, the device must be locked or secured to maintain physical security.

8.1.2 Store samples in a locked storage area. For example, when collecting samples for a period of time before transporting to the laboratory, lock the samples in a secure storage area or in an area with controlled access such as a locked vehicle or locked field office.

8.1.3 Use security seals where appropriate. Although security seals do not provide physical security, the seals are evidence that the samples or sampling process was not tampered with while unattended.

8.1.4 Use best professional judgment when providing physical security of the samples or sampling process. The sampler should be knowledgeable of the programmatic requirements for the samples and provide the appropriate degree of physical security.

8.2 Document in field logs, or other project documents, the type of physical security used.

9. Keywords

9.1 Chain-of-sample-custody record, form, laboratory, physical security, samples, and shipper.

Environmental Procedures Catalog

Document Addition/Revision

Procedure Title Standard Practice for Equipment Decontamination [GN-13(P)], Rev. 1, 6/92

Requester Sam Campbell

Justification Project specific policy regarding equipment decontamination water. (1)
(2) Revision of reference document due to finalization of ASTM procedure (D5088-90)

Proposed Changes (list here or attach copies) (1) Equipment decontamination from millsite and downgradient groundwater well sampling will be collected and disposed in Pond 3 or in the drain of the decontamination pad at the east enterance to the millsite which drains to Pond 3. (2) Section 3.1 add American Society for Testing and Materials, "Standard Practice for the Decontamination of Field Equipment Used at Non-Radioactive Waste Sites", D5088-90, 1991.

New Document

Change to Procedure

Adopt Procedure

Approval for Inclusion in *Environmental Procedures Catalog* Procedure Number Assigned ________

Manager, Compliance Management *Date*

Project-Specific Change for Operable Unit III, Annual Monitoring Program
Project

Reviewed by Craig S Goodknight 2/25/97 Approved by [signature] 2/25/97
(Technical Author or Senior Proficient Designee) *(date)* *Manager or Designee* *(date)*

Effective Date 4/1/97

GJO 1787
2/97

Standard Practice for Equipment Decontamination

1. Scope

1.1 This practice may be followed if more-specific information is not provided in individual test methods or practices. Decontamination of equipment and instruments is necessary to minimize the spread of contaminants within a site and from the site, to reduce worker exposure to potentially hazardous materials, and to prevent cross contamination of samples and ensure data quality and reliability. The degree and type of decontamination is dependent on the type of material(s) being sampled and the analytical considerations for the sample. This practice does not describe decontamination of personnel.

2. Hazard Analysis

2.1 Decontamination may pose hazards to individuals under certain circumstances or if care is not exercised. Personnel should consider the following observations before proceeding with decontamination procedures.

2.1.1 Decontamination methods may be incompatible with the hazardous substance(s) being removed and cause reactions that produce heat, toxic fumes, or explosions.

2.1.2 Decontamination methods may be incompatible with clothing or equipment being decontaminated; for example, organic solvents or acids may permeate and/or degrade protective clothing or equipment.

2.1.3 Decontamination methods may pose a direct hazard to workers if protection from acid rinses is not taken, or adequate and safe working conditions are not provided in the area where decontamination is conducted.

2.2 To control decontamination hazards, site investigators shall use information from the historical research of a site and shall apply common sense. The determination can be made before sampling commences if there is potential chemical and physical incompatibility of decontamination solutions with expected site contaminants and sampling equipment. Sources to contact include the Geotech Analytical Laboratory, Material Safety Data Sheets (MSDSs), and manufacturers of equipment suspected of producing deleterious reactions with cleaning solutions. The use of personal protective clothing will provide protection from acid rinses. Decontamination work areas must have adequate working space and be organized to minimize awkward or strenuous movements by workers.

3. Referenced Documents

3.1 Geotech, *Work Plan for Groundwater Monitoring at the DOE/Kansas City Plant*, UNC/GJ–KC–1, Grand Junction Projects Office, Grand Junction, CO, 1990.

3.2 National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (EPA), and U.S. Coast Guard (USCG), *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, available from EPA or the U.S. Government Printing Office, Washington, D.C., 1985.

3.3 U.S. Department of Energy, *The DOE Environmental Survey Manual*, Appendix G, Decontamination Guidance, DOE/EH–0053, 1987.

3.4 U.S. Environmental Protection Agency (EPA), *A Compendium of Superfund Field Operations Methods*, EPA/540/P–87/001.

3.5 U.S. Environmental Protection Agency, "EPA Hazardous Materials Incident Response Operations," *Environmental Response Team Training Manual*, 1985.

3.6 U.S. Environmental Protection Agency, *Personnel Protection and Safety*, available from the EPA Office of Emergency and Remedial Response Hazardous Response Support Division, Environmental Response Team, 1986.

4. Significance and Use

4.1 The purpose of this practice is to provide guidance for the decontamination of field tools and equipment used in the collection of soils, sludges, liquids, and gases that will be submitted for physical and chemical analyses.

4.2 Investigators will be familiar with site-specific conditions and specific sample needs before collecting samples and will use the most efficient and cost-effective decontamination procedures that are based on specific-site conditions and the purposes for the samples. Investigators may add to or modify these procedures as needs arise.

4.3 This practice is designed for use mainly with chemical wastes. Transuranic radioactive wastes, biological materials, or combinations of these materials should be considered individually for decontamination procedural design. Site investigators should consult the Geotech Health, Safety, and Security Section and Environmental Services Section for additional information.

4.4 This practice is applicable to the decontamination of most conventional sampling tools and equipment composed of metals and synthetic materials. Site managers and Field Team leaders should consult the manufacturers of any tools or equipment that may be of unusual composition for possible reactivity with cleaning methods and solutions or rinsing agents.

4.5 Consideration should be given to the use of dedicated sampling equipment if legitimate concerns exist for the production of undesirable and/or unmanageable waste byproducts during the decontamination of tools and equipment.

4.6 Decontamination methods should be used generally before, between, and after the completion of sampling events.

4.7 Personal decontamination is described in references 3.2, 3.4, and 3.6, available from the EPA. Reference 3.3 discusses decontamination of both equipment and personnel.

5. Terminology

5.1 *Contaminant*—An undesirable substance not normally present or an unusually high concentration of a naturally occurring substance in gas, water, or soil.

5.2 *Contaminate*—To make impure or corrupt by contact or mixture.

5.3 *Contamination*—The act of process of contaminating.

5.4 *Decontamination*—The process of removing or reducing to a known or acceptable level undesirable physical and/or chemical constituents from sampling apparatus, equipment, or personnel.

5.5 *Equipment*—Materials such as tools, gear, or provisions used to accomplish a task.

5.6 *Hazardous Material*—(1) A substance or material that has been determined by the Secretary of Transportation to be capable of imposing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated (by the U.S. Department of Energy); (2) a substance or material that is capable of posing unreasonable risks to living organisms.

5.7 *Site*—A physical location.

5.8 *Waste (as a pollutant)*—A substance or mixture that, after release into the environment and upon exposure to any organism, will or may reasonably be anticipated to cause adverse effects in such organisms or their offspring.

6. Procedure

6.1 *Decontamination Plan*—A site decontamination plan should be developed for each site before any personnel or equipment enter the work area. The following information should be included in the plan:

6.1.1 Number and location of decontamination stations (a map is suggested). If formal zones are established for a site, the decontamination stations should be located in the Contamination Reduction Zone, usually near the edge of the Support Zone (the clean area), if equipment is to leave the site. Otherwise, the stations may be mobile to accommodate sampling plans.

6.1.2 A list of anticipated equipment that will be needed for sampling and equipment/supplies that will be needed for decontamination.

6.1.3 A list of appropriate methods for decontamination.

6.1.4 A set of established guidelines for release of equipment and personnel (i.e., what is "clean?") that satisfy local, State, and Federal regulations.

6.1.5 Methods for determining if equipment is adequately cleaned may include the following:

6.1.5.1 Visual observation in natural light for discolorations, dirt, stains, and corrosive effects.

6.1.5.2 Visual observation in ultraviolet light for yellowish fluorescence associated with some polycyclic aromatic hydrocarbons.

6.1.5.3 Use of organic "sniffers" such as organic vapor analyzer (OVA) monitors.

6.1.5.4 Swipe-testing analysis for later verification results.

6.1.5.5 Cleaning-solution analysis for later verification results.

6.1.5.6 Testing for permeability, which requires the removal of some part of the equipment or clothing for later analysis.

6.1.4 A set of established logistics for containing any contaminated rinses and materials generated during decontamination.

6.1.5 A set of established methods for disposing of decontamination rinses and used materials.

6.2 The plan should be revised as needed to adequately provide for decontamination of new or unanticipated substances or site conditions.

6.3 The practice presents four methods for the decontamination of equipment. The methods may be used individually or in combination to achieve a higher level of decontamination. The proper method or combination of methods will depend on the type of contaminants, level of decontamination required, and purpose of decontamination. Pressurized water or steam cleaning may be appropriate to perform initial decontamination of equipment in Methods A, B, C, and D. It is strongly recommended that the person performing the decontamination always wear protective gloves during the decontamination event.

Method A – Decontamination Using Control Water

Method B – Decontamination Using Detergent and Control Water

Method C – Decontamination Using an Organic Desorbing Agent

Method D – Decontamination Using an Inorganic Desorbing Agent

Method A
Decontamination Using Control Water

7. Significance and Use

7.1 This decontamination method is considered to be the minimum amount of decontamination that must be used to clean equipment. Its use is limited to those cases where the sampling equipment has only contacted relatively uncontaminated materials and there is little chance of contact with organic substances.

8. Apparatus

8.1 Control water. This is defined as water having a known chemistry. Deionized or distilled water is sufficient.

8.2 Wash bottle or pressure sprayer to dispense the control water.

8.3 Kimwipes or other lint-free tissues.

8.4 Brushes and scrapers made of inert material.

9. Procedure

9.1 Remove any solid material from the equipment by scraping or brushing with implements made of inert material.

9.2 Thoroughly rinse the piece of equipment with control water using a pressure sprayer or pressure from a wash bottle.

9.3 For equipment such as tubing and pumps that cannot be easily dismantled for cleaning with a pressure sprayer or wash bottle, circulate control water through the equipment.

9.4 Dry the equipment with Kimwipes or other lint-free tissues.

9.5 Store equipment in a manner that will minimize it from possible contamination by surface and atmospheric contaminants.

10. Comments

10.1 This method represents the minimum amount of decontamination that should be performed. Cross contamination of samples is possible if organic or other substances are not removed physically or by the control water.

Method B
Decontamination Using Detergent and Control Water

11. Significance and Use

11.1 This decontamination method is used when the material being sampled is not easily removed or tends to adsorb onto the equipment. This method employs a mild detergent wash that can chemically remove contaminants that are not removed by Method A.

12. Apparatus

12.1 Control water. Control water is defined as water of a known chemistry. Distilled or deionized water is adequate.

12.2 Pressure sprayer or wash bottle.

12.3 Kimwipes or other lint-free tissue.

12.4 Brushes and scrapers made of inert materials.

12.5 Detergent. This detergent should be phosphate-free, biodegradable, and soluble in hot or cold water. Isoclean, Alquinox, or Liquinox are acceptable.

13. Procedure

13.1 Remove any solid material from the equipment by scraping or brushing with implements made of inert material.

13.2 Wash and scrub the equipment thoroughly with the detergent solution using a brush.

13.3 Rinse the equipment thoroughly using control water.

13.4 Circulate the detergent solution through the equipment, followed by circulation of the control rinse, for equipment like tubing and pumps that cannot be easily dismantled for cleaning with a pressure sprayer or wash bottle.

13.5 Dry the equipment with Kimwipes or other lint-free tissues.

13.6 Store equipment in a manner that will minimize possible contamination by surface and atmospheric contaminants.

14. Comments

14.1 This method has less potential for cross contamination of samples than Method A but may not be adequate to decontaminate equipment that is grossly contaminated. Methods C and D should be added as necessary.

Method C
Decontamination Using an Organic Desorbing Agent

15. Significance and Use

15.1 This decontamination method should be used in cases when organic contamination of the sampling equipment has occurred or is suspected and when Method A or Method B is not sufficient to clean the equipment.

15.2 The choice of organic desorbing agent will depend on the kind of organic contaminant present and the analytical requirements of the sample being collected. Generally, a pesticide grade of methanol is recommended (methanol does not interfere with gas chromatography/mass spectroscopy [GC/MS] analysis); however, stronger desorbing agents like acetone or hexane may be required for proper decontamination.

16. Apparatus

16.1 Control water. Control water is defined as water of a known chemistry. Distilled or deionized water is adequate.

16.2 Pressure sprayers or wash bottles.

16.3 Brushes and scrapers made of inert material.

16.4 Organic desorbing agent, such as methanol, acetone, or hexane.

16.5 Kimwipes or other lint-free tissues.

17. Procedure

17.1 Clean any surface particles or film from the equipment with a scraper or brush made of inert material.

17.2 Wash with control water using a pressure sprayer or wash bottle.

17.3 Wash with the organic desorbing agent using a pressure sprayer or wash bottle. Protect skin from contact with organic agents.

17.4 Rinse with control water.

17.5 Dry with Kimwipes or other lint-free tissues.

17.6 Circulate decontamination liquids through equipment in the order listed above for equipment like tubing or pumps that cannot be easily dismantled for cleaning.

18. Comments

18.1 This method has less potential for cross contamination of samples with site contaminants than Method A or Method B but has a risk of contaminating the sample with organic desorbing agents.

Method D
Decontamination Using an Inorganic Desorbing Agent

19. Significance and Use

19.1 This method should be used to remove inorganic substances that have adsorbed onto sampling equipment and when Methods A and B are not sufficient to remove the substances.

20. Apparatus

20.1 Control water. Control water is defined as water with a known chemistry. Distilled or deionized water is acceptable.

20.2 Brushes or scrapers made of inert material.

20.3 Pressure sprayers or wash bottles.

20.4 Inorganic desorbing agent. An inorganic desorbing agent may be 10 percent nitric acid or 10 percent hydrochloric acid made from reagent-grade stock and deionized or distilled water. Other acids or combinations of acids prepared in a similar fashion may be appropriate.

21. Procedure

21.1 Remove any solid material from the equipment by scraping or brushing with inert tools.

21.2 Wash the equipment thoroughly with control water using a pressure sprayer or wash bottle.

21.3 Wash the equipment with an inorganic desorbing agent using a pressure sprayer or wash bottle. Protect skin from contact with inorganic desorbing agents.

21.4 Thoroughly rinse equipment with control water.

21.5 Dry equipment with Kimwipes o other lint-free tissues.

21.6 Circulate decontamination liquids through equipment in the order listed above for equipment such as tubing and pumps that cannot be easily dismantled for cleaning.

22. Comments

22.1 This decontamination method has the least potential for cross contamination of a sample with inorganic elements from the site but has a potential for contaminating the sample with inorganic desorbing agents. Additionally, strong desorbing agents such as the acids used in this method may dissolve or leach elements or compounds from the next sample, and great care must be taken to remove all acidic residues from the sampling equipment.

23. Quality Assurance

23.1 The following information should be recorded in the field logs or notebooks concerning decontamination of equipment:

23.1.1 Person responsible for performing the decontamination.

23.1.2 Method or methods used.

23.1.3 Control water used.

23.1.4 Type and quality of the organic and/or inorganic desorbing agent(s) used.

23.1.5 Location where decontamination was performed.

23.1.6 Other information as necessary: e.g., record of rinse or wipe samples before initial equipment decontamination and prior to its use for sampling to establish a baseline level of contaminant on the equipment, and record of final rinse or wipe samples after equipment has been decontaminated.

24. Heavy Equipment

24.1 Because heavy equipment is difficult to decontaminate, cover equipment with disposable covers or wraps to avoid contamination. However, decontamination will be unavoidable in many cases. Bulldozers, trucks, backhoes, drill rigs, drilling tools, and other heavy equipment are usually decontaminated by steam cleaning or high-pressure washes with water and/or detergent solutions. The decontamination method that will be used is a function of the degree and nature of the contaminant and the degree of decontamination that must be achieved. Generally, wet contamination will be kept wet and dry contamination will be kept dry. Wetting some compounds may cause chemical reactions that will react with equipment and produce undesirable substances that are more difficult to remove. The following general steps may be used for decontaminating heavy equipment:

24.1.1 Physically remove any bulk material adhering to the contaminated item by use of a wire brush or stiff bristle brush or scraper. Dry cleaning can be further accomplished using vacuum cleaners or sand blasting. For wet cleaning, use water or nonphosphate detergent (under pressure if necessary) to assist in the final removal of materials.

24.1.2 Steam clean the item.

24.1.3 Use a pesticide-grade methanol rinse if contamination is persistent.

24.1.4 Rinse with control water. Control water is defined as either deionized or distilled water.

24.1.5 Collect a wipe sample for analysis.

24.1.6 Repeat 24.1.1–24.1.4 as necessary if item is found or thought to be still contaminated.

24.2 Conduct decontamination procedures in an area where contaminated materials can be contained, such as a wash pad. Cleaning and rinsing solutions may be recycled or trapped as necessary. It is important to control the volume of decontamination solutions when expensive measures must be used for their disposal.

24.3 All portions of the equipment, including the undercarriage, chassis, and cab, must be decontaminated. Air filters should be checked and will often be contaminated if dusty conditions are encountered. A thorough visual inspection of equipment supplemented by wipes, as appropriate, will be used to determine the best method for decontamination and the decision to use higher levels of decontamination.

25. Keywords

25.1 Contaminant, contaminate, contamination, decontaminate, decontamination, equipment, inorganic, organic, sampling, and waste.